ILLUSTRATED
ELECTRICAL REVIEW
A Journal of Scientific and Electrical Progress.

VOL. 24. No. 4. WEEKLY. | NEW YORK, WEDNESDAY, JANUARY 24, 1894. | $3 per Annum. Single Copies, 10 Cents.

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Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

Paris anarchists are now sending threats by telephone.

A new electrically-propelled carriage is being introduced by M. Paul Pouchain, of Armentières, France. The carriage will carry six persons. The electrical energy is supplied by a battery of 54 Dujardin accumulators. The motor is of the Rechinewski type, with an output of 2,000 watts. It is fixed in the center of the vehicle, and transmits its power by chain gearing to the driving wheel. According to the inventor the total weight of the carriage and equipment is about one and one-third tons. One charge of the accumulators is sufficient for a journey of about 44 miles at a speed of 10 miles per hour.

A new time table has been arranged on the Fifth Avenue Trolley Line in Brooklyn, which is satisfactory to the men and which, it is expected, will enable the cars to be run with greater safety. It fixes the working time at nine hours and 54 minutes a day and holds the motormen under strict orders not to run their cars at a higher speed than eight miles an hour. Under no circumstances is the average speed to exceed a mile in seven minutes.

A big colliery in Lanarkshire, Scotland, is to be lighted by electricity throughout. The electric light plant, as proposed, is divided into three parts. In the first the dynamo will run 300 lamps in the colliery itself, to be distributed both throughout the pit and above ground. Another is devoted to the lighting of thirty-four workmen's cottages, which are about 700 yards from the colliery, there being three lights in each cottage, or a total of 102 lamps in all. The third consists of a complete electric pumping plant, capable of delivering 100 gallons of water per minute from the adjacent river to the colliery. The dynamos for the lighting of the pit and the workmen's cottages are being so constructed that each dynamo can be used for either purpose. Both machines are designed to give a constant pressure of current at the cottages; that is, no matter what demand for current there may be at any time in other parts of the plant, there will never be a dim light in the workman's cottage.

The Church of England Synod, in session at Montreal, after an exciting debate, has unanimously declared against the running of street cars on Sunday as opposed to the proper observance of the Lord's Day.

There are about 152,000 street cars in operation in the United States.

An interesting electrical experiment was successfully exhibited at the College of Physicians and Surgeons in Baltimore last week. By means of a flexible rubber tube a diminutive electric light was introduced into the stomach of a patient. The lights in the rooms being lowered, over 200 persons viewed the workings of the patient's internal organs through the transparency the light created in the abdominal wall. Professor Julius Friedenwald conducted the experiment.

Representatives of 20 electric companies were hanging on the garments of the members of the Board of County Commissioners to-day. They submitted bids yesterday, as reported, for lighting the county buildings with electricity. To-day each was trying to demonstrate that his bid was by far the best, if not actually the lowest. The commissioners remarked that each of the light bidders was "bright." This was justified by the appearance of the men, who were for the most part young and alert, educated skillfully in technical schools. The commissioners ageed to hear each in detail on his bid. No contract for the lighting plant will we awarded this week.—*Indianapolis News.*

The Westinghouse interests at Pittsburgh have contributed $10,000 to the Citizens' Relief Fund of that city.

During a recent gale the smoke stack of the electric light company at Nantucket, Mass., that tight little island 30 miles from the mainland, blew away, and the town was left in darkness.

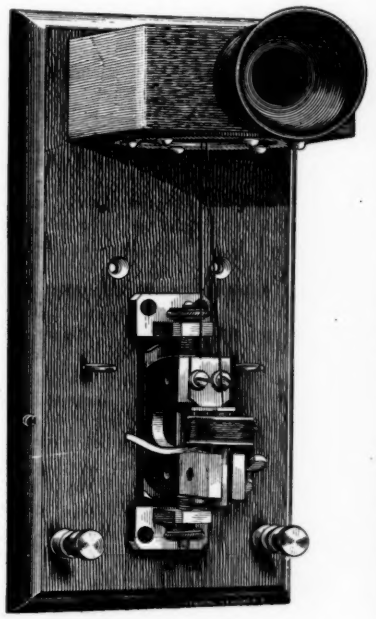


FIG. 1.—FIELD'S MULTI-DIAPHRAGM TELEPHONE WITH COVER REMOVED.

First of the Cooper Union Lectures.

On Monday evening, January 15, the first of the University Extension lectures on electricity, under the auspices of Columbia College, with the co-operation of the Cooper Union, was delivered in the large lecture hall at Cooper Union by Mr. C. O. Mailloux. His subject was 'Batteries—Primary, Secondary and Thermo."

The lecture was popular in character and was attentively listened to by about 400 persons. The audience consisted of school boys, college students, linemen, wiremen, engineers, electrical supply dealers, consulting engineers and contractors.

FIG. 2.—FIELD'S MULTI-DIAPHRAGM TELEPHONE READY FOR USE.

If the remaining lectures are as well attended as the first one, those in charge should provide a larger and better ventilated hall for the audience. There were about 300 seats and over 400 people in the room. There was little or no ventilation, a cause of great discomfort, which was intensified by the delay in beginning the lecture, which did not commence until 8.30 o'clock, owing to the apparatus used for purposes of illustration not being in working order.

Electric Traction in Switzerland.

Several of the street railways at Geneva, including the Carouge, Geneva, Chêne route, are to be converted into electric lines. An electric street railway is also to be constructed between Altorf and Flüelen.

Field's Multi-Diaphragm Telephone.

In the ELECTRICAL REVIEW for November 18, 1893, we presented to our readers a reproduction from the patent drawings of the new multi-diaphragm magneto telephone recently produced by Mr. Stephen D. Field. The success attendant upon the operation of this telephone has been so pronounced that we publish herewith two illustrations of the apparatus in its latest form. Fig. 1 showing the mechanism with the protecting box removed, and Fig. 2 showing it as it appears when ready for use. In the apparatus from which our illustrations are made, but two diaphragms are used, each being two inches in diameter and .012 inch in thickness. From the center of these diaphragms two No. 30 wires are taken and attached to opposite ends of a centrally pivoted armature, the wires from the upper diaphragm passing through without touching the lower one. As these two diaphragms are in the same plane and the upper one about an inch and a quarter farther distant from the armature than the lower one, it follows that simultaneous minute impulses delivered to both diaphragms will take longer in traveling over the wire connected to the upper diaphragm than over the one connected to the lower. This minute defect it compensated for by making the shorter wire of brass and the longer one of steel. Longitudinal sound impulses travel faster in steel than in brass, so by a proper adjustment of lengths exactly simultaneous action is obtained upon both ends of the armature.

The armature consists of a bar of soft iron one inch in length, one-quarter inch wide and one-thirty-second of an inch in thickness. The generating coil has a resistance of 50 ohms, and surrounds a soft iron core one-quarter inch in diameter.

This apparatus has been worked practically on a 500 mile circuit, and as the principle upon which it is constructed admits of indefinite extension it would seem as if it presented a serious rival to the Standard carbon transmitters. The apparatus answers as a receiver as well as transmitter; it is loud, clear and distinct in operation, and bids fair to have a large sphere of usefulness.

An Itinerant Electrical Object Lesson.

Mr. Frank W. Hawley, vice-president of the Cataract General Electric Company, who had charge of the canal electrical experiments near Rochester in December last, will ask permission of the superintendent of Public Works to operate his boat on the State waterways next season as a sort of object lesson in the uses of electricity. He proposes to have a new boat of the most approved pattern, equipped with a propeller wheel of the latest design, and in place of the trolley used in the experiments already mentioned, proposes to use storage batteries to operate the Westinghouse motors that drive the shaft to which the wheel is attached. Two series of storage batteries will be used. On one side of the boat will be arranged the chloride accumulators of the Electric Storage Battery Company, of Philadelphia, and on the other side a series of batteries furnished by the General Electric Launch Company, of New York. It is the intention to place upon this electric boat a number of devices for the use of electricity in daily life, and to exhibit these everywhere along the line of the canal.

Essential Station Instruments.

READ BEFORE THE NORTHWESTERN ELECTRICAL ASSOCIATION, MILWAUKEE, JANUARY 17, 1894, BY PROF. D. C. JACKSON.

When Mr. Thom notified me to appear before you and discuss the subject of "Essential Station Instruments," I submitted. People are in the habit of submitting to Mr. Thom when he demands anything, from paying their bill for electricity to voting on Election day. In this case I was pleased with submission, as I am happy to be able to meet you again. But to come to our subject, "Essential Station Instruments." As the subject was assigned me, I make it my text, but will draw such a moral as to me seems best. The term, station instruments, may be made to cover a variety of tools and indicating devices from the coal shovel to the main fuse block. We need not discuss all the mechanical and will look at the electrical end first. The essential electrical instruments are such as will enable your station men to handle your dynamos and look after their regulation with the greatest precision, but with the expenditure of the least of the labor and with the least possibility of accident. With the usual construction, the electric instruments are mounted collectively on a switch board, but seldom in the best manner. Remember that accidents may involve, first, the operator; second, the plant; third, any branch of the plant.

Safety for careful operators is usually provided, but unfortunately the safety of the plant is seldom properly considered. Boiler explosions and fires are likely to involve serious destruction, and proper precautionary measures are frequently overlooked. Fortunately, boiler explosions are not frequent in electric stations, but fires have been far too frequent and disastrous in their occurrence. A great many of the fires in electric stations start at the switch board. These can be made almost absolutely safe, and with proper construction switch board fires should be almost unknown. How many of you have in your stations properly constructed switch boards? And, though you have taken the usual precautions of industrial establishments against fires, how many of you pay a fairly low rate of insurance on your stations? A saving of 25 cents on your insurance rates will pay for considerable improvement in the switch board. By making the improvements and insisting upon intelligent inspection by the insurance companies, you can gain the improved rates. At the same time, you guarantee yourselves against fire. This is better than insurance, for however well the insurance companies may treat you after a fire, they will never repay all the losses you may incur. Build your switch boards of non-combustible material. Marble is not very expensive, and is better than slate. If combustible material is used for the board, never make it solid, but arrange it simply as a skeleton upon which the instruments may be secured. Set the switch board at least two feet (three feet is better) from the wall, and have all the wiring done in the best possible manner and in plain sight. Under no circumstances close the ends of the space back of the board, making it into a sort of rubbish closet. Keep the space all around the board light and clean. Nothing will guarantee neat, safe wiring and safe storage of material except the entire absence from the station of dark corners and closets. There are, by the way, few station hands who will wire a switch board in a neat and safe manner without excessive expense unless they are carefully directed.

The switch board should be located conveniently, and the instruments conveniently placed thereon. The dynamo instruments should be bunched together, and the different devices belonging to each individual dynamo circuit should be placed in vertical rows. This avoids the probability of the accidents to machinery which are bound to occur when the instruments are irregularly distributed. System at the switch board is just as important to economy as is system in the accounting methods. Pressure indicators, cutting-in galvanometers, ground detectors, and other instruments which are common to all the dynamos should be placed where they are easily seen by a man at the dynamo regulators.

Devices placed in the feeder circuits may be placed either above or at one side of the dynamo instruments. In any case the arrangement should be such that extensions may be readily made.

The number of instruments on the dynamo and feeder circuits should never be multiplied unnecessarily. Their type and number, in any case, depends upon the type of the apparatus and the purpose for which it is used. Thus arc light plants require an arrangement which differs completely from that which is required in alternating stations, and the latter differs from that required in stations supplying a continuous current constant pressure distribution. If arc light dynamos with separate regulators or controllers are used, these should be solidly mounted near the dynamos to which they belong. In each case the maximum of safety and convenience should be sought in the choice and arrangement of the instruments. The arrangement of the standard panel switch boards of two or three prominent manufacturing companies may be followed with profit. Where two or more classes of machinery are used, the different types of dynamos should be set together, and the switch boards should be distinct, but side by side.

Let us drop the electrical question now and go over to the steam side. We will start with the coal bin and simply touch upon the instruments and tools not generally used, but which can usually be advantageously added to the equipment, that is, which are likely to add to the dividend-paying capacity of the station. The first instrument on this list is a platform scales for weighing in the coal. Daily records of coal consumed should be carefully kept and compared with records of the electrical output day by day, week by week and month by month. Complete daily records enable a station manager to determine whether he is getting the greatest results with the least expense, as he can determine the question in no other way. The coal records also enable a direct comparison of the economy of different grades of coal. Many station managers give too little attention to this matter, simply purchasing the grade of coal which happens to have the lowest price per ton. This is frequently all right, but sometimes it is not economical.

The coal shovel is an essential instrument (a very essential one), which requires a great deal of careful supervision. The coal records and automatic records of steam pressure serve this purpose. An automatic steam pressure recorder is not an expensive instrument. If one is properly installed and its indications are acted upon by the manager, it will soon save its cost. There are various automatic recorders. A first-rate one is the Bristol. The Edson, which is more expensive, has some advantages, which are, however, of little moment in a small plant. Those of you who have operated stations both where pressure recorders are and are not used will doubtless be ready to bear witness to their advantages.

Thermometers in the feed water pipe and in the steam pipe are not essential to the operation of a station, but they are certainly advantageous. A throttling calorimeter, made up of ordinary fittings, is also serviceable. The use of the thermometers and calorimeter may look to you like kid-glove engineering, but if you are anxious to get the greatest result from your steam plant for the least cost, you will use them. They are not kid-glove affairs, but good common sense appliances. Steam gauges on the boilers (good reliable ones), all will agree, are essential, but it is not usual to put one in the steam pipe near the engine. It is a good idea, however. I am acquainted with a plant of considerable size which operates 24 hours in the day. During the daylight the load on the plant is small, and the day engine races badly because it is underloaded when the steam pressure is held to its usual 100 pounds. In such cases, it is the impulse of the average fireman and engineman to throttle the steam by partially closing the boiler valve. In the station I speak of the reduction in the pressure is 20 pounds. Let us see the result. In first bringing the boiler pressure up to 100 pounds above the atmosphere, a certain amount of heat is furnished to the steam from the fuel. Where the pressure is reduced by throttling, the steam is cooled to a lower temperature and some of the heat contained in the high pressure steam is lost. This loss means an equal decrease in the power of the steam, and therefore the coal which was used in raising the pressure from the low value to the high one is simply thrown away. When it is necessary, on account of light day loads, it is much more economical to lower the boiler pressure to a satisfactory figure. In the station referred to the loss in fuel on account of throttling was from eight to 10 per cent. Five to 10 per cent. of the fuel used on day load makes a considerable item in the period of a year, which will pay for the recording boiler gauge and a gauge in the engine pipe, besides adding a sum to the divident account. It is true that the gauge in the engine pipe does not remove the fireman's impulse to reduce pressure by throttling, but if his work is constantly under inspection, the impulse is much less likely to be irresistible. In this connection, let me remark regarding the usual practice of cutting off the condenser at times of light load when condensing engines are used. Under such circumstances, fuel is saved by keeping the condenser running, but reducing the boiler pressure to hold the engine cut off at an economical point.

Another instrument of much use is the engine indicator. This is particularly useful in determining whether the engines are working at their most economical cut-off and whether the valves are properly set. A great many engineers keep fooling with their engine valves and rely upon their eye and ear to set them properly. This is generally poor economy, and the indicator should be brought into requisition. If cards are taken at fixed intervals and filed for reference, they may be made a decided aid in the effort to keep everything at the most economical point. In the valve setting alone, if the indicator can point out the way of saving a very small per cent. of fuel, it will quickly pay for itself in this country of expensive coal. The horse-power calculated from the diagrams compared with water and fuel records and again with electrical records give all the elements necessary for determining at any time whether the plant is doing its duty satisfactorily. I have spoken particularly of instruments that are frequently not used in the stations, but which can be made of much valuable assistance in reducing expenses. These are not varnished, theoretical ideas, but hard common sense dividend earning suggestions. They can be put into service without increasing the operating costs in any way, and the instruments will ordinarily quickly pay for themselves. What I have said is probably not new to any of you, but there are some old ideas, the reassertion of which it pays to listen to and discuss.

The Waring Company Files a Bond.

The Waring Electric Company, of Manchester, Conn., has filed the bond of $10,000 required, pending the appeal from the injunction issued by the United States Circuit Court in the suit of the Edison Electric Company and others against the Waring Company on an infringement of the Novak incandescent lamp. The bond was executed by Maro S. Chapman, as president of the company, and Maro S. Chapman and Nathan T. Pulsifer as sureties. Clerk Edwin E. Marvin, of the United States Court, forwarded to Clerk John A. Shields, of the United States Circuit Court of Appeals, New York, all the papers, exhibits, etc., in the suit.

The Brooklyn *Citizen* Almanac for 1894 contains 500 pages of interesting statistics and splendid maps of Brooklyn.

ELECTRICAL MEN AT MILWAUKEE.

MEETING OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The Northwestern Electrical Association held a convention at Milwaukee, Wis., on Wednesday, Thursday and Friday, January 17, 18 and 19. The attendance was very good and the papers interesting.

Elsewhere in this issue will be found several of the papers read and others will be published later.

THE ATTENDANCE.

Among those present were the following:

Herman Audrac, Milwaukee, Wis.; F. Overbaugh, Chicago; L. V. Gibbs, M. H. Johnson, Milwaukee, Wis.; H. D. Latimer, Chicago; Pliny Norcross, Janesville, Wis.; W. Goltz, Mayor H. C. Kock, Milwaukee, Wis.; C. C. Paige, Oshkosh, Wis.; W. B. Baker, Waupaca, Wis.; E. L. Debell, Sheboygan, Wis.; H. C. Thom, Madison, Wis.; John Shulte, Manitowoc, Wis.; John Wiley, Hancock, Wis.; J. P. Lord, Waupaca, Wis.; Carroll Collins, Green Bay, Wis.; M. L. Stevenson, Cleveland, O.; George Mayo, W. D. Ball, Chicago; H. D. Goodwin, Milwaukee, Wis.; D. S. Terry, Chicago; W. H. Thorpe, Beaver Dam, Wis.; A. C. Bunce, W. J. Ferris, W. C. Wheaton, Chicago; O. D. Kleinsteuber, Milwaukee, Wis.; J. Earl, Kaukauna, Wis.; T. G. Grier, Chicago; J. A. Berkley, Little Falls, Minn.; C. A. Spencer, Centralia, Wis.; W. W. Low, Chicago; G. L. Cole, Beloit, Wis.; H. Amundson, La Crosse, Wis.; E. Engrebreton, Whitewater, Wis.; M. A. Burt, Baraboo, Wis.; C. D. Johnson, Tomah, Wis.; T. F. Grover, James Motley, Milwaukee, Wis.; S. F. B. Morse, Chicago; J. H. Trever, Antigo, Wis.; J. A. Andrews, Hudson, Wis.; G. S. Whyte, Fred. De Land, ELECTRICAL REVIEW, W. Forman Collins, Chicago; S. G. Coleman, Milwaukee, Wis.; G. F. Merrill, Ashland, Wis.; R. F. Kountz, M. L. Stevenson, Milwaukee, Wis.; D. C. Jackson, Madison, Wis.; O. M. Rau, Milwaukee, Wis.; F. N. Boyer, Chicago; Geo. Grimm, Jefferson, Wis.; P. T. McFadden, Chicago; E. K. Patton, Boston.

At the Wednesday evening session the election of officers occurred, and the following were elected:

President, C. C. Paige, Oshkosh, Wis.; first vice-president, W. B. Baker, Waupaca, Wis.; second vice president, E. L. Debell, Sheboygan, Wis.; secretary, H. C. Thom, Madison, Wis.; treasurer, G. F. Merrill, Ashland, Wis. Directors, W. Goltz, Milwaukee, Wis.; Pliny Norcross, Janesville, Wis.; John Shutte, Manitowoc, Wis.

ELECTRIC LIGHT FLASHES.

Dover, N. H., is talking municipal street lighting.

Batavia, N. Y., is getting ready to put in its own village electric light plant.

The City Council of Portsmouth, Ohio, has sold the electric light plant to the Electric Railroad Company.

Higginsville, Mo., has voted twice on propositions for electric lights and water works, and is still without either.

The new electric light plant at Port Deposit, Md., on the site of the one which was burned two years ago will be completed in a few days and the town will be once more lighted by electricity.

A very strong deputation of managers of Canadian electric light companies waited upon the Government in Ottawa, recently, to express approval of the proposition of Controller Wood to pass legislation for the inspection of electric light meters.

The National Carbon Company, Cleveland, Ohio, whose factory was partly destroyed by fire recently, has resumed work. The part of the works that was most severely dealt with by the fire was the moulding department. This will be rebuilt, but the remainder of the works has been repaired.

The proceedings brought by the Edison Electric Light Company against the Manufacturers' Club, the Spreckels Sugar Refining Company and a number of other defendants in Philadelphia, in which injunctions are asked to restrain the use of incandescent electric lamps, alleged to contain infringments on the plaintiff's patents, will most likely be heard before Judge Acheson soon in the Circuit Court at Pittsburgh.

Economic Use of Transformers.

READ BEFORE NORTHWESTERN ELECTRICAL ASSOCIATION, JANUARY 17-19, 1894,
BY W. FORMAN COLLINS.

In the distribution of electrical energy by means of alternating currents, the transformer may be considered to be the key to the situation, because by its use we are enabled to so change the form of the energy, as regards its electro-motive force and current, as to render it suitable for the operation of all kinds of translating devices, and transmit it from point to point cheaply and with small loss, and it accomplishes all this for us without any rotating or moving parts, which is its most important feature of value. In fact, a transformer performs a function for the energy of an alternating current that may be closely likened to that which electricity does in enabling mechanical energy primarily to be carried from place to place by a perfectly inert conductor without the employment of moving parts, such as belts, shafts or wire ropes. Having such a device it is evident that it is a most important point to utilize it as economically as possible in any work which we may desire to do, in the first place by making the device itself as efficient as we can, and in the second by so distributing and arranging them that the best results may be obtained, and absolute certainty of good and continued service with minimum loss and expense be assured.

By considering the several features of transformers and studying the way in which they operate we can arrive at the right way to secure the greatest economy in their use. Perhaps the best way to do this is to look at the problem as follows: The actions that go on in a transformer, the losses that occur, the methods of construction and distribution.

ACTIONS.

A transformer is, to all intents and purposes, similar to a dynamo which has no rotating armature, but in which instead the magnetic lines of force are caused to alternate rapidly by connection to a source of alternating current; an electro-motive force is produced in the primary coil by the alternating source varying the magnetic lines that link through the coil, these in turn pass through the secondary coil which is in inductive relation to the primary and produce an electro-motive force in it also, because the two coils are connected magnetically by being wound about the same iron core. The rate at which the magnetic lines due to the primary current are cut by the secondary coil represent a measure of the electro-motive force given to the secondary. The magnetizations produced in the primary and secondary coils are proportional to their ampere turns and will, of course, oppose one another, thus lowering the actual magnetism produced in the iron core; the lines of force threading both coils, are the resultant effect of the two forces.

The voltage produced at the terminals of the secondary coil depends simply upon the ratio of number of turns of the wire in each coil, provided the induction is the same through both. If the length of wire in the two coils is the same, the electro-motive forces would be the same, similarly if the length of the primary is 20 times that of the secondary they would be as 20 to 1, for instance, at the quite usual pressure of 1,000 volts on the primary the secondary would be 50.

A transformer on an alternating circuit possesses inherently a property of inductive resistance or impedence which is similar in its action and effects to the back electro-motive force of an ordinary motor, which only allows the absorption of a very small current when there is no work being done by the motor, this small current being sufficient to rotate the armature and overcome the frictional and other losses. The inductive resistance of the primary acts in the same way, opposing the pressure on it and almost balancing it in a well designed transformer, so that but a small current is absorbed in the primary when there is no work being done by the secondary in supplying lamps or other apparatus. It was the overlooking of this fact that caused the gentleman who tried to test a transformer with a 1,000 volt direct current on the primary to witness some very surprising and startling effects on his instruments and converter.

LOSSES.

There are several sources of loss in a transformer which may be divided into two classes; magnetic losses or those which take place in the iron and conductor losses, or those which take place in the copper coils. The former comprise magnetic leakage, the loss by hysteresis due to the rapid reversal of the magnetism, heating of the iron core, and eddy currents. The latter, the drop or loss of voltage in overcoming the resistance of the copper conductors and the energy dissipated in heat, which varies as the square of the current passing. Magnetic leakage is due to the fact that some of the magnetic lines of force leak out along the core instead of passing through the secondary; this leakage effect is increased by the opposing magnectic action of the secondary to that of the primary, and the direct result is the lowering of the electro-motive force of the secondary; even when there is no load on the secondary some magnetic leakage is taking place. When the transformer is running light the primary coil absorbs current enough to produce a field sufficiently strong to balance the voltage of the primary. The current thus absorbed is termed the "idle" current, and it is, of course, necessary to have it very small. To force current through the primary, an electro-motive force must be supplied sufficient to counterbalance that induced by the magnetic field and that lost by hysteresis and eddy currents and in resistance. The magnetizing current, which varies in accordance with the quality of the iron, produces the magnetization which forces the lines around the core and furnishes the energy wasted by hysteresis and eddy currents. The loss in the iron from the reversal of the magnetism is a constant one, whether the load is full, partial or none at all. This is clearly demonstrated by the presence of the "idle" current in the primary coil when none is being generated in the secondary.

The iron loss is dependent on the induction, and the amount and kind of iron used. It is generally conceded to be most advantageous to have the losses in the iron as small as possible, because they are continuous and are going on all the time irrespective of the conditions of the external circuit. On the other hand, the copper losses are only maximum during the periods of full or very near full load, which is not the general condition of the transformers, although it should be; therefore, it is unnecessary to have them unduly small; furthermore, the element of cost enters quite markedly into this portion of the subject. When there is no load there is practically no loss in the conductors.

CONSTRUCTION.

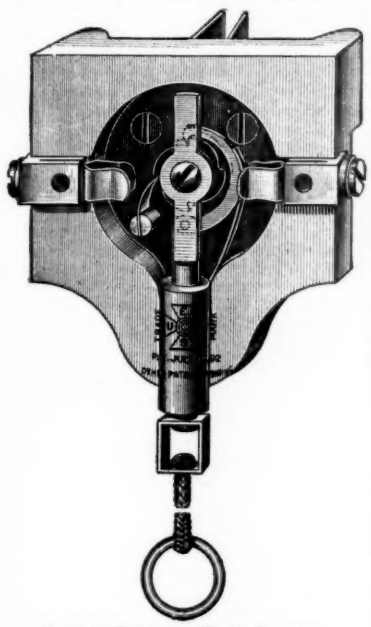
It is very important to have a well designed and carefully built transformer, because the coal bill will be most wonderfully affected by the employment of wasteful and inefficient apparatus. We have seen from the properties of converters that the many conditions to be satisfied are quite contradictory, and the course which improves one portion of the apparatus will be detrimental in some other way. In designing, therefore, it is necessary to strike a mean such that we obtain the best general effect as regards efficiency and reliability with moderate cost. The best transformer being the one that has the greatest output and efficiency with the least weight and cost. The insulation of the coils is of prime consideration and it cannot be too good. The primary and secondary coils must be insulated from one another and from the iron core thoroughly and with the best quality of material, of a character unaffected by heat or moisture, and they must be securely protected from the weather, which is done by incasing the entire converter in a water-tight iron case. For very high tensions the coils are often completely immersed in oil, which gives excellent results.

The number of magnetic lines passing through the coils should be as great as possible, as then the amount of copper required in the coils will be small. The coils should be as small as possible and the employment of iron cores which is always done produces high magnetic induction with small current, thus cheapening the cost of manufacture.

Transformers are generally built with closed iron magnetic circuit to reduce leakage and keep down the primary magnetizing current. It may be well to mention here incidentally the "hedgehog" type of transformer due to Mr. James Swinburne, which uses an open iron magnetic circuit of special form. The argument in favor of this plan is that while the magnetizing current and copper loss is larger, the loss due to reversal of magnetism and heating in the iron which is always occurring is exceedingly small, and that on light loads particularly, this type will waste very little energy. It is, however, very questionable whether the general results are in the end superior to those of closed circuit transformers such as are generally used in this country, and if properly arranged so as to work under favorable conditions the well designed closed circuit type will probably prove to have decided advantages. Converters are generally constructed either with the copper coils surrounding iron or the iron surrounding the copper coils, and while in the first arrangement the amount of copper is less, the iron is more, and in the second *vice versa*, they both give approximately the same results.

Care should be taken to have the resistance of the coils low, to prevent drop of voltage and heating, and the leakage small; and to carry out the latter condition the coils should be placed, preferably, one surrounding the other, but should not be wound so that their turns interlace or in alternate layers. The cores must be of finely divided iron, the laminations insulated from one another to reduce eddy currents and prevent heating. Stampings are generally used because the manufacturing cost is thus lowered. Sufficient iron should be employed to make the magnetic resistance low and prevent waste of current and power at no load or on light loads. Both coils and magnetic circuit should be short, with provision for sufficient room for the coils. A low induction must be employed to prevent undue heating, and the iron must not, even at full load, approach the saturation point. The co-efficient of induction is the number of volts produced per foot of wire, and is found by measuring the current produced in the primary with the given electro-motive force and number of alternations when the secondary is open. When obtained it enables all sizes of similar type to be built. The higher the alternations the higher the co-efficients, but on account of the increased losses and other considerations, the present tendency is toward lower alternations, which also permit of coupling the alternators safely and conveniently in parallel, and make practicable the satisfactory operation of the various forms of alternating current motors which have been recently produced. In the great Niagara distribution the low periodicity of 25 is, it is understood, to be used for these and other reasons.

Testing transformers is essentially a laboratory operation, but is quite important, and a thorough comparative test of all the various makes by competent and disinterested persons, with full data and tables of their performances under varied conditions, would be most interesting to central station men. Naturally, the way to obtain the efficiency is to measure by a suitable wattmeter the



STIRN'S ELECTRIC PULL SWITCH.

power delivered and that absorbed, and divide the former by the latter. On account of the high pressure of the primary it is customary to use a small converter whose primary is connected to the high electro-motive force, and its secondary to the pressure coil of the wattmeter.

A well made closed iron circuit transformer should give a high efficiency not only at full load, but also on light load. For measuring alternating currents the various dynamometer instruments, and the well-known Cardew voltmeters, are quite accurate for practical work; although probably the most exact way is to use the electrometer which, however, is not well adapted for ordinary work, as it is exceedingly delicate and requires suitable conditions and considerable skill and care in handling.

DISTRIBUTION.

It is quite as necessary to arrange the transformers for any particular distribution so as to obtain the most economical performance at all times as to secure transformers of high efficiency in the first place. With the primary pressure constant, as the load on the station is increased the tendency of the secondary voltage is to drop on account of the leakage and the ohmic resistance of the coils. This must be compensated for at the station so as to maintain the pressure of the secondary circuits constant to insure good service from the arc or incandescent lamps and motors that may be connected. A good transformer, however, supplied with constant electro-motive force should give very nearly constant electro-motive force on the secondary for all loads within its capacity. The usual conditions of a lot of transformers run from a central station is that of light loads and often for a great portion of the time without any load at all. Under these circumstances it is easy to understand why they should use only a very small "idle" current, because power is being wasted all the while furnishing this "idle" current and heating the iron cores, and as pointed out above we can afford to sacrifice a little energy in copper loss, which only occurs during full or nearly full loads, to enable the continuous iron losses to be reduced to the very lowest possible point.

It has been observed by all operating alternating plants that with a non-inductive resistance, such as incandescent lamps, the drop under varying load is smallest, being greater on arc lamps or motors, because of the presence of self-induction in the latter, and it is even possible to have an actual rise in pressure, as was experienced on the long cables of the huge Ferranti station at Deptford, England, and ascribed to their capacity action.

For running arc lamps it is not desirable to have the periodicity too low; about 50 is generally used. The average loss in distribution by alternating currents is remarkably small, about five to 10 per cent., divided up about equally between the circuits and transformers. Loss of energy is proportional to the square of the current employed, and the weight of copper required varies inversely as the square of the electro-motive force; or, in other words, one fourth of the amount of copper is required to transmit any given amount of energy at twice the pressure, which, with the large amount of power carried at high pressure and low current by the alternating system, makes the cost of copper and waste of power both small, and renders possible the long transmission already carried out and those of even more daring proportions proposed.

It is evident that a small converter will not be nearly as efficient as a large one, because the magnetic circuit cannot be as short, relatively speaking, or the copper coils as compactly arranged, and it will heat far more; it is also plain that a small converter will cost more per lamp output than a larger one. From these two most vital considerations large transformers are both cheaper and more economical and less of them are necessary. They can be just as desirably used as a number of smaller ones, by taking a little care in laying out the circuits and distributing them so as to reach as many consumers as possible with a single large transformer and its attendant advantages. At first sight it might appear as if the increased amount of copper used in the larger secondary mains would be injudicious, but this is not so (provided, of course, discretion is used), because the slight additional cost of conductors is completely overbalanced by the diminution of losses in the transformers, which are permanent and continuous.

The regulation of large transformers is also superior; they are much lighter for their output and cost less to install.

The difference in efficiency is quite marked between a 10 light converter and a 100 light one; for instance, while the former will probably have a full load efficiency of 88 or 90 per cent., the latter will be as high as 95 to 97 per cent.

Summing up the conclusions arrived at, it is apparent that to fulfill the requirements of most economical operation, transformers of the highest all-round efficiency under varying load should be used, and so far as circumstances permit, let them be large in size and few in number.

Stirn's Electric Pull Switch.

The illustration herewith shows a very ingenious pull switch for use on electroliers or combination gas and electric fixtures. It consists of a porcelain body to which the switch device is attached, and at the back of which is an extension clamp for attaching the switch to the gas pipe under cover of the ceiling canopy of the fixture. The clamp is adjustable to piping from one-half to one and three-quarter inch diameter. When used as a wall switch, the clamp is removed and the porcelain block is fastened to the wall by screws through holes provided for that purpose.

The switch mechanism is simple and appears to be durable. It has brushing contacts which are kept bright by use. The make and break is instantaneous, and is accomplished by a slight pull on the chain. The switch is easily attached to a fixture and is moderate in price. It is made by the Universal Pull Socket Company, 27 Beaver street, New York.

New General Electric Buildings at Schenectady.

It was reported last week that plans are in preparation for an immense storehouse and office building to be erected at the plant of the General Electric Company at Schenectady. The work will probably be commenced early in the Spring.

The Theory and Design of the Closed Coil Constant Current Dynamo.

READ BEFORE THE ELECTRICAL SECTION OF THE FRANKLIN INSTITUTE, DECEMBER 26, 1893, BY HENRY S. CARHART.

(*Concluded from page 27.*)

The second method diminishes the overlap of the brushes as they are rocked forward. In the first place this has the effect of diminishing the time allowed for the reversal of the current, but it also diminishes the number of turns of wire in the coil or coils included between the two parts of each brush. The curtailed time interval increases the self-induction of each convolution of wire, because it increases the rate of change of the current in the coil undergoing commutation; but this increase is counterbalanced by the diminution in the number of turns of wire short-circuited by the brush. Hence, the total self-induction during commutation remains not far from constant. When the brushes shift forward into a denser field, however, the diminution in the overlap decreases the number of turns of wire included between the pair of brushes composing either the positive or the negative, and so cuts down the total field induction in those coils during commutation to the amount required to suppress sparking. The overlap of the brushes must, therefore, be inversely as the induction in a coil under the brush in different parts of the field, for the presence of the pole of the armature at any point reduces the induction. This point is a complicated one, and needs further experimental study.

But in the third class of machines the overlap of the brush is constant, and the field is not weakened by cutting out coils on small load. Neither are the pole faces cut away to produce uniform induction. Attention is given to the thickness of the pole-pieces, so as to avoid unnecessary crowding of the lines of force toward the central portions. It is also desirable to avoid thinning of the polar horns lest they become saturated. In the old Sperry machine, which I have investigated quite carefully, each pole-piece is cut quite in two. In fact, as is well known, the field has four cores. At the same time the horns or pole tips are rather blunt. But this machine shows the violent sparking when separately excited with the brushes far forward and the circuit through the armature open. The induction round the armature is not uniform, but the sparking is small for any position of the brushes with the normal current. The brush bears on about three commutator segments. I refer to this machine as an illustration of the class, and not as a model of excellence. It is no longer built.

In this machine the induction to which a coil is subjected near the brush is not the same in different parts of the field, but diminishes as the brushes are rocked forward, the current being kept constant. With the exploring coil before described and the two extra brushes bearing on the insulated copper ring and the fibre collar with brass segment respectively, the external circuit connecting the two small brushes was carried through a d'Arsonval galvanometer in shunt. The two extra brushes were attached to the two main brush holders, but were insulated therefrom. With one brush making contact with the small brass segment, two and then three commutator bars in advance of the upper main brush, the following deflections were obtained with the galvanometer from maximum to minimum load, the steps being about equal:

Deflection two segments.	Deflection three segments.
26	63.5
24	56
22	49
20	41
18	34
16.5	32
13.5	28
12.5	
10.5	

The steps were not the same in the two series of observations. No trouble was found in obtaining a steady deflection of the galvanometer, the dynamo making about 1,200 revolutions per minute. The exploring coil was, therefore, subject to a diminishing induction near the brush as it moved forward with the brush toward the center of the polar surface.

A similar series of experiments made on an old Gramme machine of 3,000 or 4,000 watts capacity, built at the University of Michigan in 1876–77, gave a different result. The measurements were made by simply connecting a third brush to the upper brush holder and measuring the potential difference between it and the main brush in different parts of the field. The actual induction to which the armature wire is subjected in different parts of the field and at the same distance of two commutator bars from the main brush is thus measured.

The following table contains one series of observations:

No. of observation.	Current in amperes.	Potential difference between main brushes.	Potential difference between main and third brush.
1	9.5	191	4.9
2	9.5	170	5.4
3	9.5	145	5.5
4	9.5	127	6.2
5	9.5	111	6.5
6	9.5	77	7.7
7	9.5	62	7.8
8	9.5	54	7 7
9	9.5	47	7.4

In this case the induction increases throughout the larger extent of the movement of the brush. But in this machine the knee of the characteristic curve is reached at about 18 amperes, while in the other machine it is found at seven amperes. The armature reaction in this older machine when run at 10 amperes is relatively less than in the other one run with the same current. This is further evident from the fact that with the old Gramme run at 10 amperes an increase in the current, due to lessening the external resistance, is always accompanied by an increase in the potential difference between the main and the third brush; while with the 10 light Sperry machine, and others with similarly saturated field, an increase in the current when the brushes are fixed decreases the potential difference between the main and the extra brush. The reason is this: If the field is saturated, but not the armature, an increase in the current does not appreciably increase the field, but it does increase the armature reaction, and so cuts down the total potential difference between the main brushes as well as between one main and a third brush; while with an unsaturated field and a magnetically weaker armature, an increment of the main current produces a greater increment in the field than in the armature reaction. With the same old Gramme machine run at about 18 amperes, an increment in the current produced a decrease in the potential difference both between the main brushes and the main and third brush. The armature reaction then became relatively larger than the increase in the field magnetism. But this old machine exhibits perfectly the property of governing by rocking forward the brushes on a diminishing load, with no more sparking in one position of the brushes than in another.

Hence, it is clear that for practically sparkless commutation, it is not necessary that the induction *near* but *under* the brush shall be a constant. The effective means by which, with constant current, the brushes can be set in any plane round the commutator cylinder, is the reactive effect of the armature. This fact is brought out quite clearly by plotting the integrated potential differences between the upper or positive brush and the third movable one as ordinates to a horizontal line. The data are the same as were employed to plot the first curve in Fig. 1. If Fig. 2 is examined, a decided flattening in the curve will be found at 180 degrees, the position of the negative brush. The same flattening may be seen at 0 degrees. All curves plotted with data obtained at different loads, show the same diminution or stay of the inductive process near the poles of the armature. The armature at these points paralyzes the field. As the poles of the armature move round they sweep away the lines of force of the field, and only enough remain to produce an electro-motive force competent to offset the electro-motive force of self-induction, and, in addition, cause the newly directed current to grow to its normal value as the coil passes out from under the brush.

This reactive power of the armature may be utilized to effect approximate regulation for constant current without brush shifting. But for this purpose the load cannot be a maximum. The poles of the armature must be far enough forward to produce increase of magnetic leakage. As an example of what I mean, a 40 light machine had its brushes locked in such a position that it maintained 30 lights with 10 amperes current. Ten lights were then cut off, and then 10 more, with but small increase of sparking, and the ammeter showed an increase of current from 10 to 12 amperes only. A change of two amperes is within limits possible for practical lighting. The machine was then completely short-circuited by placing a large bar of iron across its terminals without dangerous sparking. This means that the characteristic of the machine beyond a crown of the curve approached a vertical line, the ideal characteristic of an automatic constant current dynamo.

The conditions requisite for sparkless commutation of a constant current machine are therefore quite clearly defined. The self-induction of the short-circuited coils must nearly balance the field in all positions of the brushes. Both Mr. Esson, in a paper before the British Institute of Electrical Engineers*, and Professor Ryan, in a paper before the American Institute of Electrical Engineers†, lay down the condition that the brushes must be kept under the pole faces in order not to enter the weakened field between the pole corners. And yet I have seen constant current machines working with the brushes beyond the extreme tips of the poles with no increase of sparking. I do not regard this condition as absolutely essential, since at maximum electro-motive force the brushes may be moved through a considerable angle without appreciable change in sparking.

Professor Ryan states, in his paper above referred to, that "the magnetizing force impressed by the field ampere turns must be uniform at all points between the pole faces." This condition is favorable to sparkless commutation, but not essential. It has to do with the area of the sparkless position of the brushes for any given load. If the field is fairly uniform this area will be about the same in different parts of the polar faces; if the field is far from uniform sparkless commutation may yet be secured; but a smaller variation in the current will produce more sparking than when the field is uniform, for the sparkless area on either side of the brush, with a given external resistance, is then much reduced. The region controlled by the armature poles is more limited in extent than when the field is uniform.

It follows that the single magnet type of field is not suitable for a constant current machine. This fact was remarked upon by Mr. Esson. For a two-pole machine the double magnet type of field is to be preferred. If, then, the iron is reduced at the back, opposite the middle of the polar surfaces, and the poles are thickened and rounded off rather blunt at the ends, to prevent saturation, the field induction will be sufficiently uniform without the necessity of resorting to the chopping away process applied to an English single magnet machine described in Slingo & Brooker's "Electrical Engineering."

Quoting from Professor Ryan: "The air gap is made of such a depth that the ampere turns required to set up the magnetization through the armature without current, and for the production of the highest electro-motive force that the machine will be called on to give, shall be a little more than the armature ampere turns when it furnishes its normal current. Then as long as the brushes are kept under the pole faces the non-sparking point will be wherever the brushes are placed. This will be the case whether the armature is or is not saturated." Again: "The impressed field ampere turns are in excess of the armature ampere turns by that amount, which is just sufficient to produce a weak positive field that will reverse the current in the coil when its terminal bars at the commutator pass under the brush." This latter statement appears to be borne out by the data given, but the machine experimented on was one giving a maximum of only 35 volts and 22 amperes, and its performance can scarcely be considered a sufficient guide for the design of machine required to furnish several thousand volts and a current of from 9.5 to 10 amperes. Again, I have known a 40 light machine converted into a 50 light without any change in the field whatever. The armature either contained more iron or was wound with a larger number of turns of wire. Both methods have been followed without effect on the sparking. The first method leaves the armature ampere turns the same; the second increases them 25 per cent. If the relation pointed out by Professor Ryan holds in the first armature it cannot also hold in the second with such a material increase in armature turns.

Further, if this relation does hold there still remains unanswered the question of relative cross-section of iron in armature and field. Shall the core of the armature be saturated or not? Mr. Esson says 17,000 lines per square centimeter is the best practice in England for constant potential machines.

I know of one constant current machine in which the armature core is forced well up toward the highest saturation obtainable with a dynamo machine. It is able to produce very high electro-motive force, but it does not govern sparklessly by means of a single pair of brushes. Two other types of machines, of which I have data, work with 11,000 lines per square centimeter in the armature. In both of these, recent changes are along the line of increasing iron and decreasing copper in the armature. I have explicitly advised the use of more iron in the armature for two years. One manufacturer recently told me that he is now following my advice with most gratifying results. With the same number of turns on the armature the output is greatly increased. To what extent the iron in the armature can be increased is an open question. It has now been carried beyond a cross-section equal to 75 per cent. of the wrought iron in the field cores. If increased cross-section of the core introduces sparking, this can be avoided by increasing the number of bars on the commutator so as to decrease the self-induction in the section under the short circuit by the brush. Indeed, if the output is kept the same, increase of iron decreases turns of wire, and to that extent decreases self-induction. In a machine with two pairs of brushes the effect is to diminish the angular embrace of each pair.

It is interesting to compare two machines of almost exactly the same capacity, but differing widely in relative core section and armature turns. Let the two machines be represented by A and B. The data of the two are given in the following table:

	Machine A.	Machine B.
Total Volts	2,900	2,800
Revolutions per minute	1,000	875
Segments in Commutator	132	120
Turns per Segment	36	72
Total turns	4,752	8,640
Cross-Section of Iron—Square inch	36.5	14.0
Lines per square inch	70,800	79,000

The maximum number of lines of force running through the armature of the A machine is 3,650,000; the B machine, 2,213,000. The two machines are designed for the same current of a little under 10 amperes. The ratio of the ampere turns on the armatures of the two is nearly inversely as the cross-section of their iron cores. The ampere turns on the B armature is 82 per cent. greater than on the A armature. It is not probable that the field ampere turns on B is 82 per cent. in excess of those on A. Unfortunately those particular data are lacking, but the magnetic circuit of A is quite as good as that of B. It does not appear at all probable, therefore, that Professor Ryan's rule applies to both machines. It is gratifying to our national pride that American designers have successfully carried the Gramme ring constant current dynamo to an output far beyond what some foreign electricians with more theory and less practice in this direction still declare to be impracticable. The writer of a series of articles now running in the London *Electrical Review** says: "Beyond about 1,000 volts it is found, in general, to be impracticable to work a closed coil armature; for either there will be a wasteful lead, or there will be vicious sparking under the brushes, or the current will flash from strip to strip, and will destroy the commutator." * * * "It seems more than probable that machines of this kind will not stand any serious alteration of load if worked at higher voltages, owing to the great range of lead which would be required, and the constant sparking and flashing over." Again he says: "There is, of necessity, a large armature reaction in certain forms of arc light machines; and when this is the case, the brushes would require to be shifted right into the center of the pole arc before sparking would cease, if there were very many turns on each section. The wastefulness of this practice consists in the large number of back-turns and cross-turns which it involves." But in the face of such declarations as these a large number of American machines are now running at an output of 9.6 amperes, and from 5,000 to 10,000 volts. A very considerable number of closed coil Gramme rings, giving 5,000 volts, are in actual use without breakdown and without any of the fatal drawbacks predicted by the writer quoted.

The design of closed coil Gramme rings for high potential arc lighting has thus far been limited to the two-pole type of field magnet. This involves the maintenance of higher speed than engineers find desirable. The conditions of present practice and the requirements for the immediate future demand a new departure in this class of dynamo design. All indications point toward a multi-polar machine of about 50 kilowatts capacity and slow speed. The armature will contain a liberal amount of iron, much larger than would be found desirable for constant potential machines. Such a dynamo is already in demand, and it will find an immediate field for the lighting of large cities.

*London *Electrician*, March 21, 1890.
†Proceedings, vol. viii., p. 465.

* *Electrical Review*, Aug. 25, 1893.

Asking Too Much.

Mrs. Chugwater—"Josiah, lay down your paper a minute."

Mr. Chugwater—"Well?"

"If a bolt of lightning should start to travel round the globe from—Josiah!"

"Well?"

"Lay your paper down just a minute and listen. If a bolt of lightning should start to travel round the globe from east to west, and another should start and travel from west to east, the way the earth revolves, you know, would there be any difference in the—Josiah!"

"Well?"

"I say would there be any difference in speed? Which bolt of lightning would get around the earth first?"

(Picking up his paper again) "Samantha, do you take me for a lightning calculator?"—*Chicago Daily Tribune.*

A Method of Determining Instantaneous Values of a Periodic Electro-motive Force.

BY FREDERICK H. LORING.

In scientific investigations we often have to resort to methods that are rather startling and perhaps ridiculous; but if such methods prove practical they cease to be out of place or incongruous to our sense of fitness. The principal feature of the method here described has indeed a shocking aspect, but has proved by repeated trials to be thoroughly practical.

To obtain curves of electro-motive force and current in the laboratory, where conditions are at their best—where sensitive instruments are not affected by vibration, and by magnetic disturbances due to moving masses of iron—it is no great task; but in a shop among machinery and with a thousand things to militate against delicate work, it is difficult, unless a rough and ready method with reasonable accuracy is available.

Some time ago Mr. Ralph D. Mershon presented a method of considerable practical merit, for obtaining instantaneous values of a periodic electro-motive force.*

As the method here described is a modification of Mr. Mershon's, I quote his words relating to the description of the apparatus, in order that the reader may get a just idea of his method and also better understand mine.

"In Fig. 1 let A B represent the terminals of the source of a periodic electro-motive force whose wave form is to be determined. C is the contact device attached, of course, to the shaft of the generator furnishing the periodic electro-motive force. T is a telephone receiver, which may have in parallel with it a condenser K. R is a resistance in series with a direct-current dynamo or storage battery; a part of R consists of a slide-wire resistance, along which the sliding contact p can be moved. V is a direct-current voltmeter. Suppose the sliding contact p to be moved to q. The contact device C being set for some point on the electro-motive force wave other than zero, there will be heard in the telephone a succession of sharp clicks—one for every revolution of the contact device. If p be moved away from q, and the fall of potential between the points p and q on the resistance R be in such a direction as to oppose that between A and B at the point on the wave for which the contact device is set, the loudness of the clicks heard in the telephone will diminish with such movement, and a place may be found at which they are no longer heard and beyond which they become again audible. This place corresponds to an approximate equality of the steady and the unknown electro-motive force, and the reading of the voltmeter gives to a certain degree of accuracy the required instantaneous value of the periodic electro-motive force. For a more accurate determination we must adjust to zero sound by moving p up first from one side of the zero point, then from the other. In general the two settings obtained in this way will not coincide, since there is a limit to the current which can be detected by the telephone, and the point midway between them on the slide-wire resistance must be taken as the true setting. The voltmeter reading gives them true value.

"The delicacy of the telephone is much increased by placing in parallel with it a condenser. Great delicacy is not at all times, however, desirable. Should the belt driving the generator of the periodic electro-motive force have bad joints in it, or vibrate much, the vibration in speed due to either or both of these causes can be plainly noted in the telephone, as some of the clicks will be louder than others. With a delicate telephone it will probably be the case under these conditions that no point can be found at which there is no sound; whereas, if the instrument be less delicate, we may find two points of zero sound and interpolate as explained above. Hence, in some cases it is desirable to diminish the delicacy of the telephone by putting resistance in series with which setting can be made with the proper form of apparatus. Using an ordinary Bell telephone receiver, it is easily possible to make settings to $\frac{1}{100}$ of a volt."

I labored to obtain instantaneous values of electro-motive force by the above means, but as the conditions were most severe I was obliged to abandon the telephone as a means of indicating a balance between the two electro-motive forces. Owing to a rapid but very slight fluctuation of the load on the circuit, the alternating current that was to be measured was rough or tremulous, so to speak; and on this account it was very difficult to use the telephone even when its sensitiveness was deadened; and finally I substituted for it a part of the human body namely, *two fingers*. It is not new for electricians to use their tongue for a current detector, but to use the fingers to make accurate measurements seems incredible.

A continuous current of a few volts is not felt by the fingers, though they be wetted when applied to the electrodes or terminals of the circuit; but if the current is interrupted quite rapidly it is felt. So it is that the fingers may be the means of indicating a very small voltage, provided the current is interrupted. As the contact maker C is virtually an interrupter, the telephone receives a succession of small currents if the two opposing electro-motive forces are not

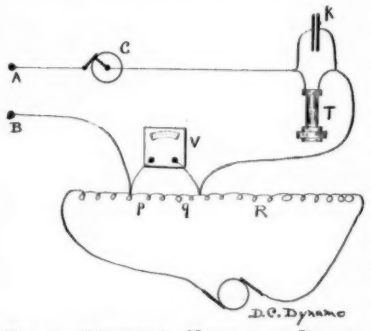


FIG. 1.—MERSHON'S METHOD OF DETERMINING INSTANTANEOUS VALUES OF A PERIODIC ELECTRO-MOTIVE FORCE.

equal. In place of the telephone are two cups, D and D_1 (Fig. 2), containing water; the water of each cup is connected to the two wires that before entered the binding posts of the telephone. Into these cups the operator places his first and second fingers, then adjusts the resistance by moving the sliding electrodes until he feels no shock; then the intermittent electro-motive force (maximum value) is equal to the continuous electo-motive force which is indicated by the Weston voltmeter.

In order to render this cup or "finger bowl" method, as it has been called, practical and not dangerous, it is necessary to have a means of gradually feeling the voltage between D and D_1. The fingers must not be thrust suddenly into the cups when the voltage between them is high; the fingers should only be immersed in the fluid when the voltage is very low. This is accomplished by having a piece of cloth or cotton-waste dipping into each cup and dangling over its side. The operator then feels his way carefully by first touching the ends of the rags that are almost dry; then gradually moves his fingers along the cloths and finally into the water. At the same time with his other hand he moves the movable electrodes, so that when his fingers enter the water the resistance is adjusted so that the two opposing electro-motive forces are nearly equal. While adjusting the continuous electro-motive force to equal the intermittent electro-motive force a point will be found when no shock is felt in the fingers. It is necessary to move along the sliding electrodes, noting the voltage at the point when the shock dies out, and again when it is just felt. The mean of these two readings is the voltage to be taken. The point where the current ceases to be felt is quite sharply defined, and the variation of two to five volts at this point is easily detected. The operator can therefore make very accurate settings. This line of demarcation, as it might be called, is quite uniform, and the exact zero is almost as accurately determined by this method as by the telephone method under fair conditions.

Great care is necessary in the operation of this method. The operator should be well insulated from the ground, and should be provided with switches and resistances so as to be able to throw high resistances into the circuit at r and r_1, when he is uncertain of the voltage across the cups or of any leaks. In cases where high voltages are to be measured the cups can be included in a secondary circuit of a transformer coils as shown by the dotted lines in Fig. 2*. The direct and alternating circuits should be well insulated from each other so that no leaks will distort the readings. It is very convenient to have the source of direct electro-motive force a small independent dynamo.

The variable resistance for varying the direct electro-motive force is an important feature in the system. I found a tank resistance more satisfactory than any other, as quick and accurate adjustment is an essential feature. This variable resistance can be understood by reference to Fig. 2.

In all my experience with this method the contact maker made in the neighborhood of 600 contacts in a minute. At a much higher rate of contact possibly the detection of a small voltage by the fingers would not be so easy.

This method is extremely accurate, quick and reliable, and I see no reason why it should not be of considerable value where the conditions are such as to render the telephone unsatisfactory.

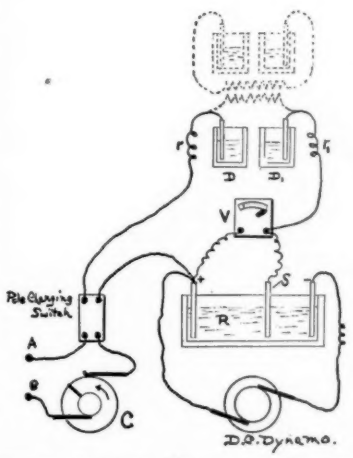


FIG. 2.—LORING'S METHOD OF DETERMINING INSTANTANEOUS VALUES OF A PERIODIC ELECTRO MOTIVE FORCE.

A Large Power Plant for South Africa.

In a recent issue we gave some particulars of a large plant which is being put down by the Moodie's Gold Mining and Exploration Company at its estate near Barbleton. We are now in possession of further details of the scheme which we give below. As we previously stated, the water-power of the Queen River is being utilized. The plant at that point comprising two Pelton water wheels, each of 125 horse-power. These are connected by means of rope driving to two "Goolden" dynamos of 120 horse-power, at a pressure of 1,500 volts. The dynamos are connected up in series. From the power house the electrical power is transmitted to the offices of the Moodie Company, a distance of four and one-half miles, by bare copper conductors suspended on ordinary iron telegraph poles. At this point the current is transformed down to 625 volts. This is accomplished by means of two "Goolden" motor generators. These motor generators comprise a motor driven by the current derived from the high tension mains, driving a generator which supplies current to the low tension network of conductors. The current is then again transmitted from the distributing house by bare overhead copper conductors to the various points at which batteries or stamps have been or are about to be erected. It is proposed at present to only connect in this way six batteries with the distributing station, the distances from the latter varying from 500 yards to about five miles. The quantity of power required at the various batteries range from 14 horse power to 42 horse-power. It is, however, intended only to use one size of motor, namely, one of 14 horse-power, two or more being connected to one battery shaft in case of necessity.

Bimetallic Wire for Telephonic Transmission.

Much attention has been given to the invention and construction of the transmitting and receiving telephonic apparatus; improvements, too, have been made in the line, but far better results with a cheaper initial cost are looked for in long distance lines.

Col. William H. Eckert has obtained letters patent for the transmission of rapidly-alternating electric currents over bimetallic wires. He finds that a bimetallic conductor is a more perfect medium for telephonic transmission than is a copper wire, that less insulation is needed to protect a bimetallic wire and that the cost of line construction is correspondingly decreased. He says that he is aware of what is popularly termed the "Ferranti effect," and that it has long been known that in the mains of Ferranti's circuit potentials are higher at a distance than at the source of generation; but notwithstanding prior knowledge of this law or effect, he believes he is the first to point out the fact that alternating transmissions are aided or made more perfect by the use of bimetallic conductors. The "Ferranti effect" is associated with a circuit in which one main is placed as an insulated wire within a conducting tube forming the return, and in this respect the organization bears a remote resemblance to his bimetallic wire. The difference, however, is obvious, and even if alternating transmissions by the Ferranti cable are aided by such an organization it does not negative his right to claim two dissimilar conductors in metallic contact with each other to form the single conductor of a metallic circuit, or to form one branch of a circuit which is completed by an earth return.

Either iron or steel may be used with copper, but steel is better adapted to the purposes of bimetallic wire and its use in transmitting alternating currents to great distances. Other dissimilar metals of essentially different specific resistances may be used to advantage in transmitting alternating currents, but to what extent their adoption would be beneficial he is unable to state. In comparing his bimetallic conductor with those of a single substance he has pointed to the fact that a single wire with an earth return may replace a metallic circuit of two equally good copper conductors; but he does not intend to limit his use of bimetallic wire to circuits having earth returns, as it is equally applicable to all other arrangements of conductors upon which rapidly alternating currents are carried.

In the use of either steel or iron with copper, while the two metals should be represented by approximately equal masses or cross-sections, there may be an excess either of copper or iron, and particularly of the latter for telephonic transmission, without materially departing from the advantages of a bimetallic conductor for carrying such currents.

The subject is one that presents a fertile field for investigation. If the claims are substantiated for lines of great length a considerable saving in line construction and in the expense of building telephonic apparatus will result.

LITERARY.

Mr. George W. Childs, of Philadelphia, has favored us with a copy of the *Public Ledger* Almanac for 1894.

We have received from F. W. Helmick, musical publisher, 265 Sixth avenue, New York, a new song entitled "Deal Gently With the Erring."

The *Review of Reviews* for January is particularly strong in its editorial *resumé* of the closing events of the stirring and turbulent year 1893. Dr. Albert Shaw, the editor, discusses tariff revision, the relief of the unemployed, recent strikes and labor questions, the Hawaiian question and the Administration's policy with regard to that subject, civil service reform as applied to our diplomatic and consular as well as other branches of the public service, and a great variety of other topics of the day.

*"A method of Determining Instantaneous Values of a Periodic Electro-motive Force." By Ralph D. Mershon.—*Electrical World*, August 29, 1891.

*I have not tried using the cups on a secondary circuit, but see no reason why it should not be practical if properly arranged.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 2339. NEW YORK.

EDITOR:
CHARLES W. PRICE.
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STEPHEN L. COLES.
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REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.

1546 "CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
H. G. TUCKERMAN, Room 29, 620 Atlantic Ave.
CHICAGO OFFICE:
FRED. De LAND, 565 "The Rookery."
WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy, - - - - - - - .10

NEW YORK, JAN. 24, 1894.

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The announcement of the Westinghouse Company in this issue has a business-like ring to it.

A number of important changes in high official circles of the General Electric Company may be expected any day.

There seems to be a large sized scandal in Philadelphia over a new telephone ordinance. The citizens are said to be much excited—even in Philadelphia.

The telephone field is just now attracting the speculative mind. This is a case in which electrical knowledge and experience should carry great weight.

Mayor Schieren intends to see that Brooklyn trolley cars do not exceed the speed of 10 miles an hour, and has directed the police department to report any faster running. President George W. Plympton, of the Brooklyn Subway Commission, states that in many instances the rate of speed exceeds 15 miles an hour. The average of several tests was about 13 miles an hour.

THE AWAKENING TELEPHONE BUSINESS.

A Wall street syndicate is said to be buying up telephone patents. Just now their mail is quite heavy.

If there is any young inventor—or old one—that has not invented a telephone, he should get to work instantly or be forever outclassed.

A word to the unwary and inexperienced: Those enormous profits from operating telephone exchanges that you hear so much about should be carefully analyzed. They may not be so enormous.

A cash contribution of $50,000 has just been placed in the coffers of a big telephone company that had its inception in the Southwest. If they intend to knock out the Bell interests as reported, that amount will be needed for attorneys' fees.

Just what the Western Union Telegraph Company thinks of the telephone situation would make mighty interesting reading. Wonder if those extra-territorial and long distance returns from the telephone interests are entirely satisfactory?

There are several gentlemen, apparently not now identified with the Bell interests, whose names would be towers of strength to new telephone companies. A few of these are T. N. Vail, E. T. Gilliland, D. H. Louderback, Stephen D. Field.

The editor of the ELECTRICAL REVIEW knows of a patent on an automatic drop telephone switch board which is for sale and on which the price has been steadily advancing for 20 days past. The lucky company will be the one, that bids big and bids quick.

The Western Telephone Construction Company, Chicago, has asked for a charter for a telephone exchange in the World's Fair city. It is expected that they will get it. Then New York, it is suspected, will be the next place this energetic company will tackle.

All this talk and hullabulloo about new telephone patents doesn't seem to disturb the equanimity of the parent Bell people at Boston. There is a solidity about their telephone successes in the past that very properly gives them confidence in the future and at the same time warns prospective competitors to move very carefully.

A Philadelphia syndicate is said to have purchased the Clamond microphone patents—patented in the United States November 15, 1892—and with them and a few others expect to completely circumvent those owned by the American Bell, particularly the Berliner transmitter. The price was $200,000 or $300,000, we forget which—a mere matter of detail.

A correspondent asks for the names of the three ablest telephone men. This is somewhat of a poser; yet the REVIEW will undertake to answer. Edward J. Hall, vice-president and general manager of the American Telephone and Telegraph Company, is the most far-seeing and ablest executive in the telephone business, and possesses the widest horizoned telephone mind in regard to the future of this wonderful instrument; Ezra T. Gilliland, not now in active telephone work, but largely interested in several companies and in a big electrical factory, is technically and practically one of the strongest names known to telephone history, and he stands second to none in the work of perfecting the early telephone exchange systems and starting them on the right road to the highest success, his inventive mind overcoming the thousand and one difficulties of those days and blazing the path with patent after patent, covering switch boards, magneto bells, signaling systems, etc.; William Dunlap Sargent, the vice-president and general manager of the New York and New Jersey Telephone Company, must be given a place with these two, though along different lines—that of handling the telephone business so as to give the best satisfaction to the subscriber, the employé and the stockholder, combining the qualities of electrician, manager and diplomat in a particularly high degree. Is our correspondent answered?

A most novel performance is now being given in this city at one of the well-known concert halls. Two Frenchmen dressed extravagantly, with bulbous and highly colored features, personate what they choose to term the "Electric Clowns." Their eyes, noses, cheeks and ears are so arranged, being supplied with miniature electric lights, that upon contact being made by means of metal plates in their shoes the intense rays of the lamps, burning above candle-power, shine forth from the darkness of the stage. The effect is decidedly unique, and the performance is a feature of the evening. This is but a step in the right direction; what we may expect in the near future is to see what would truly be a *fin de siecle* electric performance, wherein the "sumptuous repast" will be cooked by the current, the heroine's hair will be curled in the latest style with electric curling tongs, the property fireplace will be lit with the glow of electrically heated coils of wire, the scenes shifted by electric traveling cranes, and many other perfectly plausible electrically controlled operations. Already several theater curtains are actuated by electric motors, and the time is not far distant when all other motive powers and methods of illumination will be cast aside to be used only in case of emergencies.

The signs of the times point to renewed activity in electrical circles. Improvement and extension of electric lighting plants and installation of new electric railways are leading features in this movement. Widespread interest is also evident on the part of the general public, as well as the electrical, in the telephone field, and the result of the expiration of the receiver patent, January 30 next.

We are glad to note the constant improvement in every particular of our esteemed weekly contemporary, the *Street Railway Gazette*. Mr. C. E. Stump, the general manager of the paper, is to be congratulated on his new venture. His many friends in New York city will be glad to learn that he has located here and has taken permanent quarters in the Havemeyer Building.

Detroit, Michigan, is just now the Mecca of electric light men. The new municipal plant, which is to be a model one, is the cause of the pilgrimage in this direction. Mr. W. A. Jackson is the president of the commission appointed by the city to have entire charge of the installation, and this assures the adoption of progressive ideas throughout.

CORRESPONDENCE.

OUR BOSTON LETTER.

Mr. Henry S. Philbrick, of 34 Oliver street, Boston, has compiled a very interesting little pamphlet on "Aluminum" and its adaptability to various branches of the electrical trade. The subject has been carefully and thoroughly treated in a practical manner, and will be found very interesting to metal workers and others in the mechanical field.

Mr. Wm. R. Watters, for the past two years New England manager of the *Electrical World*, has severed his connection with that journal, and will hereafter represent the *Street Railway Journal* in this territory. Mr. Watters is personally very popular, and during his connection with the trade has made many friends, whose best wishes and hearty support follow him in his new line of work. Mr. Watters will make his headquarters at 620 Atlantic avenue, Boston.

The Wakefield and Stoneham Street Railway Company are equipping their cars with a new fender which they claim is really a life-saver, and which has been thoroughly tested on their cars under all possible conditions. In every instance it has done all that was required of it, and either picked the obstruction up bodily, or thrown it to one side. Col. Woodward, president of the railway company, is very enthusiastic over the results of the experiments, and will equip all his cars with the device as fast as possible.

The Schedule adopted by the West End Company for the current year has created considerable dissatisfaction among the men, and rumors of a strike have been floating about for some time past. Nothing of the kind is anticipated however, as the West End Company have always dealt very fairly by their men, and they would hesitate about taking any action of this kind. Fifteen hundred conductors, drivers and motormen held a meeting in Faneuil Hall on the 10th ult. to talk over the situation, and nine clauses of the proposition were referred to the various divisions for action.

The Shop of the W. S. Hill Electric Company, always an interesting place to those seeking something new in the line of electrical inventions, contains at the present time a completed machine which is destined to make a fortune for someone. The device in question is one for removing the particles of iron from paper pulp, and when it is remembered that pulp is sold in four different grades, graduated according to the amount of iron therein, and rising in price proportionately as the iron diminishes, the value of a machine which removes all foreign substances may readily be appreciated. Mr. W. S. Hill was largely instrumental in bringing the machine to a perfected state, and the one just completed under his supervision is the first one of the kind to be put into practical operation. It is simple in construction, and does the work thoroughly and well.

The Pennock methods of doing business were beautifully illustrated last week in the letter sent out by him signed by "Chas. R. Thomas, with Edison Illuminating Company, Boston, Mass.," and of which editorial mention was made in our issue of January 10. Mr. Thomas called on me this morning, for the purpose of setting himself right in the matter, and exposed the whole story of the transaction. Mr. Thomas, it appears, is a wireman in the employ of the Edison Company, and was approached a short time ago by a representative of Pennock's, a man, by the way, formerly in the employ of the General Electric Company, but at present out of work, and invited to examine the Pennock system of electric lighting, of which great things were promised. After hearing the details of the scheme explained to him in glowing terms, and having witnessed the remarkable workings of the mysterious "generator," he was asked to sign a document endorsing the system, and promised that in the event of his doing so, a brilliant future opened up before him, and that as soon as the new company was organized and ready for business, he would be given employment, and put in the short and direct road to fortune. Mr. Thomas, while a first-class wireman and thoroughly conversant with his own line of work, is by no means the equal in intelligence of the "only" Pennock, and it is small wonder that under the impulse of the moment, and dazzled by the brilliancy of the prospects held out to him, he should have signed a letter endorsing the system, as requested. Neither is it strange that it did not occur to him that his connection with the Edison Illuminating Company, which was so lightly touched upon, was the milk of the cocoanut which Mr. Pennock was after, and was to be used for deceiving the public into the belief that the Edison Company itself endorsed the system. Who was to know that Mr. Chas. R. Thomas was not an officer or director of the company? The phrase "with the Edison Illuminating Company" is ambiguous enough to suit even Mr. Pennock's requirements. Mr. Thomas was frank enough to say that his eyes had been opened, and that he regretted having unintentionally drawn himself and the company by whom he is employed into any connection with such a disreputable piece of business. H. G. T.

Boston, January 20.

PERSONAL.

Mr. H. Durant Cheever, of the International Okonite Company, Limited, was a Chicago visitor last week.

Mr. C. M. Morse, of the Buffalo Engineering Company, Buffalo, N. Y., was a visitor to New York city last week.

Mr. George A. Redman, superintendent of the Rochester, N. Y., Gas and Electric Company, was among the New York visitors last week.

Mr. Frank H. Clark, general manager of the United States Electric Lighting Company, of Washington, D. C., was in New York last week.

Mr. Charles A. Rolfe, general manager of the Police Telephone and Signal Company, Chicago, was a New York visitor last week, and favored the ELECTRICAL REVIEW with a call.

Mr. W. F. Holloway, superintendent of the Lancaster Carbon Company, Lancaster, N. Y., was a metropolitan visitor last week, and made the ELECTRICAL REVIEW a pleasant visit.

At Elizabeth, N. J., on January 23, Miss Nellie Lowrey Pope, daughter of Secretary Ralph W. Pope, of the American Institute of Electrical Engineers, was married to Mr. Horace Russ Wemple.

Mr. E. L. Babcock, of the Falls Rivet and Machine Company, Cuyahoga Falls, O., was in New York last week. He is rapidly recovering from the injuries he recently received by being knocked down by a truck while on a visit to New York.

Prof. Henry A. Rowland, the eminent physicist of Johns Hopkins University, won his suit against the Cataract Construction Company, for six months' services in designing the Niagara Falls electric system. The jury awarded Professor Rowland $9,500. The defendant took an appeal.

Mr. Wm. H. McKinlock, president of the Metropolitan Electric Company, of Chicago, is visiting New York and Boston in the interest of his company. The Metropolitan Company, although newly organized, is rapidly extending its business under Mr. McKinlock's able and experienced management.

Mr. A. G. Waterhouse, the electrical inventor, returned to London last week, where he will remain for some time perfecting some new electrical apparatus. The new alternating current arc lamp invented by Mr. Waterhouse is being manufactured extensively in England, and will probably soon be introduced in this country. Mr. A. T. Salisbury Jones accompanied Mr. Waterhouse on his visit to Hartford several weeks ago, and returned with him to England.

Wall Street and the Electrical Stock Market.

The improvement noted last week in commercial circles continues. The trade reports issued to-day continue in the same hopeful vein. This turn towards industrial improvement, coupled with the decision of Secretary Carlisle of issue bonds, imparted considerable strength to the market of stocks and bonds this week.

Western Union, while in a measure sharing in the advance, was in reality one of the weakest stocks on the active list. Its quotation on Monday ranged between 84⅝ and 86¼. On subsequent days in the week it sold at prices between those figures, and did not participate in the advance of Thursday or Friday. This latter fact gave rise to the theory that the heavy sales in the middle of the week were of long stock. Had they been short a covering movement would naturally have ensued on the general market advance. Mr. Amery has had an order to sell from two to three thousand shares daily for nearly a week. This is believed to be long stock. The source of the supply is shrouded in mystery. I hear reports of decreased earnings.

General Electric was active, going from 35⅝ to 38¼ on Monday. On subsequent days it sold off, touching 34 on Friday, rallying to 36¼ on the close. The closing was the price to-day. Persistent rumors that the Thomson-Houston interests were about to withdraw from General Electric through the medium of a receivership, which have been current for the past month or two, were explained by the appointment of a receiver for the Thomson-Houston Company, of New York. It was believed that this company was the Thomson-Houston faction in General Electric. Such is not the case. The facts are these: the Thomson-Houston Company, of New York, is an illuminating Company which bears no more relation to the old Thomson-Houston Company than the Edison Electric Illuminating, of New York, bore to the Edison General Electric.

The last installment amounting to $1,000,000 of the $4,250,000 syndicate formed to care for the floating debt of the General Electric Company was paid in on the 15th. On December 31 there was needed $1,000,000 to care for obligations which would mature between that date and May 1st. It is presumed that the money will be used in paying off these obligations, although some of the preferred stockholders are clamoring for $140,000 dividends due on their stock which was passed January 1.

This syndicate was formed for $4,500,000, but received a commission of 5 per cent. The securities taken over were $12,500,000, par value. The company which they formed to control these securities was the Railway and Illuminating Properties, with a capital stock of $4,500,000 preferred and $4,500,000 common. They took the preferred stock at par and received a bonus of the common stock. As they sell the assets of the company they retire the preferred stock with the money. The other day they retired $50,000 of it. It has been estimated that the value of General Electric stock on the present basis of its assets and operation is about 42. The stockholders are looking forward to a revival of the business of the company in the lighting and street railway field in common with its competitors, and claim that they will share largely therein.

The debenture 5 per cent. bonds sold in a limited way between 72 and 73½. The preferred stock sold at 60 on the Boston Exchange.

The Edison Electric Illuminating, of New York, issued its annual report this week. It is published entire in another column. It was received with very great favor by the shareholders. There were no transactions in the stock this week. The bonds sold at 103½.

The strength of American Telegraph & Cable continues. It was selling at 89 and 90. It is something unusual to see this stock in advance of Western Union, although intrinsically I believe it is worth more.

Westinghouse first preferred, par 50, was bid 46 and held at 47. The assenting par 50 was bid 25 and held at 25¼.

During the first eight months of the fiscal year, which ends April 1, the company's net earnings are said to have averaged $150,000 a month above operating expenses, and that this business was done on a cash basis. During the month of December the shipments were above the average for the previous eight months, as were also the collections. The accounts and bills payable have been reduced nearly $1,000,000 from the highest amount, and are now less than two-thirds of what they were at the beginning of the fiscal year. The company has contracts on hand that will fully occupy its force the whole of the present and into the next fiscal year. It is said that the earnings on the stock outstanding have been at the rate of 20 per cent. per annum. With regard to the new works, the East Pittsburg Improvement Company furnishes the land and erects the buildings according to the plans and specifications of the Westinghouse Electric and Manufacturing Company, and receives therefor the exact cost and quarterly payment extending over a period of six years. It is estimated that the saving in labor alone by reason of the use of modern appliances will amount to more than the quarterly payment.

On the Boston Exchange Bell Telephone dropped from 188½ to 176, on the expiration of certain of its patents next month. Erie Telephone and New England Telephone were firm at unchanged quotations. Fort Wayne Electric depreciated one per cent., being bid 4 and held at 5. The par is 25.

The Edison Electric Illuminating Company, of Brooklyn, report, to be submitted at the annual meeting next Tuesday, will show:

	1893.	1892.	Changes.
Gross earnings	$325,424	$231,001	Inc. $94,433
Operating expenses	136,038	103,847	Inc. 32,191
Net earnings	$189,395	$127,153	Inc. $62,242
Other income	8,000	.....	Inc. 8,000
Sundries	14,485	38,445	Dec. 23,960
Total	$211,880	$165,598	Inc. $46,282
Op. ex., taxes, etc.	42,822	39,317	Inc. 3,505
Net income	$169,058	$126,281	Inc. $42,777
Interest on bonds	25,000	25,000	
Balance	$144,058	$101,281	Inc. $42,777
Debs. written off	3,000	3,000	
Applicable to div's	141,058	98,281	Inc. 42,777
Dividends paid	98,276	62,250	Inc. 36,026
Surplus after div's.	$42,782	$36,031	Inc. $6,751
Carried to reserve	25,000	25,000	
Balance	$17,782	$11,031	Inc. $6,751

The taxes for 1893–1894 were $10,121, both paid. Taxes paid in December, 1892, but charged in 1893, $7,661, against $11,030 in 1892. Total stock issued $2,500,000. Total bonds issued $500,000. Surplus December 31, 1893, $63,956. For the year 1893 gross earnings increased 40 per cent.; expenses 31 per cent.; net earnings increased 49 per cent.

New York, January 20.

The Swan Lamp Company.

The annual meeting of the stockholders of the Swan Lamp Manufacturing Company was held at its offices in Cleveland, Ohio, on January 16. The following officers and directors were elected: S. M. Hamill, president and general manager; B. F. Miles, vice-president and treasurer; S. E. Cox, secretary and superintendent; E. P. Roberts, electrician. Directors, W. H. Lawrence, B. F. Miles, L. H. Rogers, Webb C. Hayes, S. M. Hamill.

A British Jest Without a Diagram.

Electricity is a very useful thing, and yet there are some people who make *light* of it. It has been (h)ampered in its introduction to our (h)omes by the uncertainty as to w(h)at it exactly costs.—*London Electricity.*

An International Telephone Line.

It is stated that negotiations are again being carried on in connection with a proposal to establish an international telephone line between Brussels, Belgium and Cologne in Germany.

William S. Hine, president; J. B. Wallace, general manager; Max A. Berg, secretary; M. M. Wood, electrical engineer, is the *personnel* of the Wallace Electric Company, Chicago, electrical manufacturers and manufacturers' agents.

The Practicability of Electric Conduit Railways.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, DECEMBER 20, 1893, BY ALBERT STETSON.

(*Continued from page 33.*)

In this place I wish to call attention to two facts—first, that the width of the slot is greater than could be allowed in any American city, since it would let into the conduit and wrench the wheels off two-thirds of our carriages. This system must have that width, since their conduit uses one of its slot-rails as a rail for the wheels of the car, and they must have the width to give room for the flange of the car wheel. The second point I wish to call attention to is the fallacy of giving the ratio of operating expenses to the net receipts. That can be manipulated in such a way that it is impossible to draw any sure conclusions therefrom. Only a short time since, a gentleman connected with the electric railway in the city where they claim to have the best roads in the country told me that their operating expenses were only 45 per cent. of their receipts. Any fair way of reckoning "operating expenses" means that, in this case, salaries and cost of running were 45 per cent. of their total expenses. If that is so, what becomes of the other 55 per cent. of income? Does it go into the pockets of the shareholders, or do the officials make way with the difference, between a "tight squeeze," seven per cent. dividend, and the large margin between 55 per cent. and seven per cent.? I am sure that no member of this Institute will be deceived by any exceedingly small "operating expenses." Another point to be noticed above is that they use only 300 volts potential. Most of us believe that Mr. Daft, in his experiments years ago, exhausted the practicabilities of electric traction at 300 volts. But, perhaps, the volts are individually more powerful in Buda-Pesth than the "North American volts" used in New York.

Crosby and Bell's book, quoted frequently before, says (page 258): "As will be seen from the description just given, the conduit itself possesses no very extraordinary features; it is simply well made, substantial and carefully drained. This latter fact is probably the most important factor in the very good results obtained. The concrete conduit is of itself a fair insulator, and serves as an additional security against grounds."

The Buda-Pesth record is certainly remarkable, standing alone as successful among all the failures that have attended conduit experiments. It has not, however, been all plain sailing, and they have had some interruptions in their traffic. What success has attended the Buda-Pesth road has been due to several causes, first of all coming the excellent workmanship that goes with everything done by the world-renowned firm of Siemens & Halske. Next come the beautiful streets of Buda-Pesth, no city in the world excelling it in finely kept and well drained streets. Labor is very cheap there; large numbers of men can be employed to keep the streets clean and the conduit clear, while our dear American labor would make "operating expenses" tell a sad tale. Third, an equable climate, enjoyed in none of our cities. Snow seldom falls there, and the rain-fall is not great. Such a state of affairs, so many favorable conditions, would be found nowhere in America, and until they are found combined, there is no good reason for thinking that the Siemens & Halske system, employing the same bare conductor and the same construction that has failed here, would do any more than add one more wreck on the shore of conduit ventures. You must remove that bare conductor from the conduit, change the climatic conditions of our country, change the laws of Nature and of electricity, or you cannot have a commercially practicable conduit system of that type. We must have a system that does not require us to change our streets and our climate, but that will take the rough and tumble conditions as they exist in all our towns, overcome all climatic difficulties, pay no attention to flooded conduits and poor drainage, and work Summer or Winter, whether the sun shines or not! If a road has a grade, and a heavy shower suddenly comes up, the water will collect in the hollows faster than any practicable drainage system can carry it away, and the successful road must work right along, undisturbed by such trifles. Any bare wire laid in a conduit, call the system by whatever name you will, must inevitably break down under such conditions. But an electric system, like any other traction system, should never break down, more especially in bad weather, when the public most need traveling accommodations.

There remains still one class of conduits to be considered before passing to the system that has shown a solution of our troubles, or as near it as we can reasonably hope to come in the immediate future.

CLOSED CONDUITS.

The idea of a closed conduit has had charms for many inventors, and much midnight oil has been consumed over this problem. The same difficulty is met with in all of them, viz., the continuous grounding of the live wire. Where magnets are used to switch in short sections of the line, they have proved a constant source of trouble. Such things often show up well in the office model, but railroads do not run in offices. All of us who have had any experience with automatic electro-magnetic switching devices know that the less number we have of them the better they work, and that we avoid them whenever it is possible. In the closed conduit, or surface contact systems, there is necessarily a momentary grounding. On a dry day, with one car, the loss might be hardly noticeable. But wet and muddy days will come in spite of the prayers of the electrician, and I always picture to myself Broadway on a muddy Winter's day, with a jam of cars reaching from the Battery to the Post-Office. Perhaps, there might be 50 time ago that Mr. Edison had invented a new system of electric traction destined to relegate the horses to the bone-yard, and cable and elevated roads to the junk shop. Such announcements from time to time, coming from so eminent a source, have done immense harm to electrical enterprises, and they would utterly annihilate the reputation of any man less favorably known than Mr. Edison. Hence there were a few doubters when the pronunciamento came, and the great results promised have all failed to materialize. The overhead system, we are told, is entirely dispensed with, cars, trucks, tracks and road bed, such as are now in use, are retained, certain changes being made in the joints and cross-ties. The power, furnished by 1,000 volt generators, is distributed to reducing apparatus placed in boiler-plate manholes at intervals varying in accordance with the number of cars required to be operated. At various reducing points the current is transformed from 1,000 volts to a

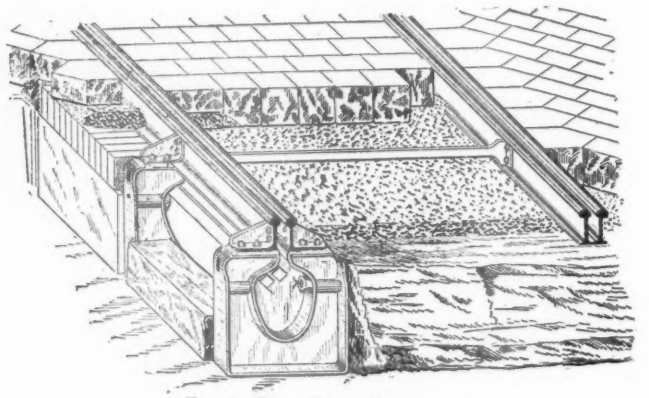

FIG. 4.—BUDA-PESTH CONDUIT.

or 75 cars in the line, and any system grounded in 75 places will certainly break down.

Among those who have worked most in this field may be mentioned—Pollak, Lineff, Gordon, Wheless, Schuckert, Edison and Van Depoele. Their systems have all very much in common, and the fundamental idea is the same.

THE GORDON AND THE LINEFF SYSTEMS.

A small conduit, two or three inches square, is closed at the top by an iron cover laid in concrete, and this iron top serves as the current conductor. It is divided up into short lengths, about one-third the length of the car, and these sections are successively alive as the car passes along, and are cut out of circuit when the car has passed.

POLLAK SYSTEM.

"In this system there is a middle contact rail in short insulated sections. The conductor carrying the current lies directly

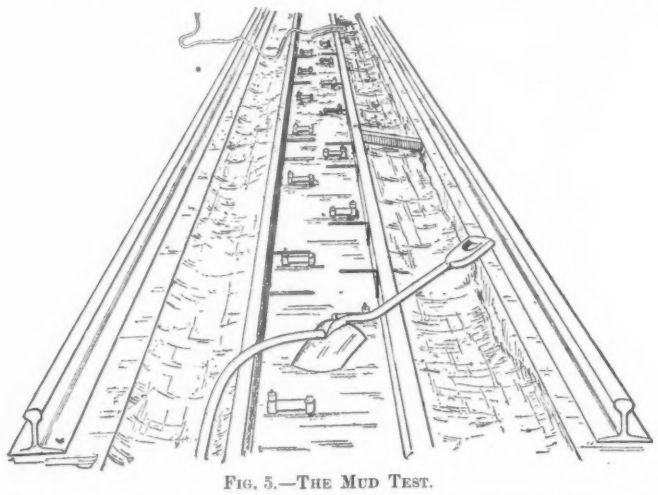

FIG. 5.—THE MUD TEST.

beneath this rail, and by means of flexible contacts momentary connections are made from it to that particular section over which the car is at that moment. These temporary connections are made by the aid of a magnet on the bottom of the car, which, in passing over, attracts iron blocks under the rails, making contact with that section."* . . .

Schuckert proposes a modification of this, by having iron filings, when influenced by a magnet carried on the car, bridge over the space between the main and the sectional rail. The holes containing the iron filings were made widest at the bottom, and it was claimed the sparking would do no harm, as the filings always present plenty of new surfaces of contact. This system is not in practical operation anywhere.

All will remember the announcement some pressure of 20 volts, and put in direct communication with the tracks. This limit of 20 volts is fixed in order to prevent horses from being affected by the current. The economy of current is about the same as with the present system of trolley.

The chances are that that road has reached its full growth, and will never extend beyond Mr. Edison's laboratory.

Mr. Van Depoele proposed a conduit closed by flexible walls. When the shoe passed the slot was to be pushed open, and the elasticity of the sides of the slot was to close the opening when the car had passed. All right, in theory; but suppose a layer of mud rests on the top of the slot when the car comes along. It opens, lets the mud into the conduit and keeps it there. A freezing temperature would soon convince the inventor that a closed conduit was an expensive ice-making machine. Such makeshifts will not do. We must work with our streets as we find them. The operative device must be simple and of few parts, and we must keep carefully in mind that a conduit at its best is a dirty place, and that iron and steel will rust, and when rusted may refuse to work.

Mr. Mansfield, in the paper already quoted, says: "There is one more system, which practically combines all these methods, and which obviates many of the objections. The inventor has a slot between his rails and boxes, with contact device within, placed at proper intervals. Upon his car is a plow which passes along through the slot, and also a long contact plate or arrangement extending its entire length. The operation of the invention is as follows: The plow, as it passes through the slot, strikes a lever in connection with each box, which lifts for a distance of six or eight inches above the ground a piston carrying the contact piece proper. This is made in the shape of a right angle hook placed in a vertically moving piston, and thoroughly insulated from it. As this is raised up, the long contact plate under the car passes beneath the hook and holds it up. The current is taken into the car as the plate slides under the live hook. Naturally, as the car passes along, the hook slides off from the end of the contact bar and drops back into place. To protect this hook, or contact piece proper, it is covered with an extension of the cylinder, so that, as far as the street is concerned, the surface is perfectly smooth, and one sees nothing but a small round cover in the center of each of these boxes. The contact hook is alive only when it is resting on the contact plate of the car. Certainly, in so far as getting rid of all troubles due to the street being covered with water, this is successful. The fatal weakness whereby the contact points remain permanently on the street surface is obviated here by the contact point being practically lifted six or eight inches above the surface."

Thus saith Mr. Mansfield, but there are some things to be looked at in this device. 1. There are too many working parts to rust and get out of order. 2. On a dry day, dirt would get into the hole out of which the contact plate is lifted, and on a muddy day the hole would be filled up immediately, so that the plate would not go back into place. It would, therefore, be necessary to have a man at each contact plate, or about every six or eight feet. The plate must go back into place, in order to leave the street level. 3. The contact plate must be made very strong, in order that it may withstand the heaviest traffic of our streets. Hence the problem of lifting and dropping such a plate as would be necessary, with the car going six or eight miles an hour, is not a simple one.

I do not wish to be rash in my judgment, but I see nothing especially promising in any of these closed conduit or surface contact devices. As Mr. Mansfield says: "Summing up the general results of the underground and surface methods, it certainly does not look as if we could expect very much from them in the immediate future."

Such was the state of the art, and such the general outlook for success, when over a year ago I became engaged in some attempts to solve the problem at Coney Island. This system was not a sudden idea, but had been a gradual development. For nearly two years it has been getting into shape, and a number of inventors have contributed their share towards its completion and success. I believe this is a good place to tell the real history of the invention. There have been many incorrect statements in the newspapers in reference to this device. No one would object to certain parties getting credit, even if it did not belong to them; but when, by giving this credit, a great injustice is done to those who did the real work, it becomes a matter of duty to set the affair forth in its true light. The original idea of the box used down there, and the working of it out to its completed form belongs, I may say modestly, to me.

Among those who have worked upon the details of the invention, I may mention Mr. G. T. Woods, Mr. C. S. Van Nuis, and Mr. John H. Dale; but whatever success it has attained has been due to the suggestions and inventions of Mr. John J. Green, who brought to the work the mind of the inventor and the skill of the trained mechanical and electrical engineer.

Such being the state of the art, the outlook being thus unpromising, knowing what had been done, having spent four months in the Patent Office, having examined the traction question on the whole continent of Europe, we set to work to construct a system that should avoid the defects inherent in other devices. To strengthen their weak points, to make an all-the-year-round system, was our object. I assert with the utmost confidence that we have succeeded. To have gone over the same old ground, in the same old way, would have been folly for anyone knowing of previous attempts and failures. Perfect insulation, no live wires in the conduit, fewest possible working parts, with nothing to get out of order. These were our cardinal points. We have not attempted to make a road operative in fine weather, and under ideal conditions; but have known that to ensure success we must take the streets as we find them. They will get muddy, rain will fall and snow will come, and if a slotted conduit road is to succeed, it must work undisturbed by them. We have, on three occasions, filled our conduit to the top with mud and water, burying out of sight conductors, contact boxes and all the devices. (The illustration, Fig. 5, shows our conduit in process of being filled.) Mud of the consistency of paste was used, and the report of a disinterested electrician, not known to me personally, brought there by the editor of one of our leading electrical journals, shows that the system was in no manner affected. With the shoe of the car in the mud, with boxes entirely submerged, the ordinary measuring instruments failed to show anything but the best insulation, and no disturbance of traffic would arise with 50 cars in a conduit filled with mud

*Hering, p. 182.

and water. No such condition would ever present itself in railway work, but a space of several hundred feet might get full of mud, snow or water, and the successful system must not be disturbed by such trifles. We made our mud test, not once, but three times. When the last test was made our boxes had been under the mud four days; yet it is to those boxes that Mr. Stevenson's report refers. Four day's submergence is a terribly hard test, but if the line then works perfectly, there is absolutely nothing to apprehend from an occasional filling up during a shower.

DESCRIPTION.

A conduit is used, similar to that of cable roads, but nothing like so large or expensive. With our improved shoe, a conduit two or three inches wide and seven inches deep will answer perfectly. In the slot of the conduit, attached to the car, runs a shoe extending nearly the length of the car.

Fig. 7 shows the shoe detached from the car; the upwardly projecting pieces are the guides for making the shoe follow the conduit and conform to the curves.

The shoe is so supported that should the car leave the track it detaches itself immediately and remains on the top of the conduit. It cannot get caught, as the cable grip sometimes does, and drag the car along through crowded streets at a dangerous speed. As seen in the illustration, the shoe is somewhat like a cigar in shape, so as not to give any sharp blow to the contact arms. The sides of the shoe are formed of conducting material, insulated from each other, and perfectly flexible, so as to follow any curves.

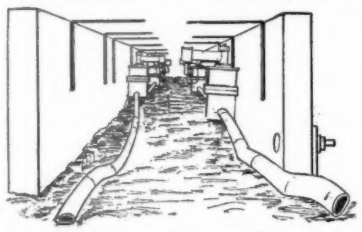

FIG. 6.—CONDUIT SHOWING CABLES AND BOXES.

The shoe can be attached to and detached from a car in five to 10 seconds.

In the conduit are placed two insulated cables, a metallic return being used. This I regard as necessary to ensure perfectly safe working. These cables run into and through contact boxes placed at intervals of 10 feet on each side, they being arranged diagonally opposite, so that the distance between the boxes is about five feet. The construction of the boxes and the functions of their various parts will be readily understood from the illustrations. One shows the box closed and the cable running into the box, the other the box opened and the method of securing contact with the cable (see Figs. 8 and 9.)

The main is carried into the box and, as can be seen, the lead and insulation removed for about two inches. On to this bared cable there is placed a brass clamp with two upwardly projecting tongues.

The contact making portion of the device is a vertical rod, having at its upper end an arm projecting into the conduit, and at its lower end a brush adapted to be brought into contact with the tongues attached to the cable. This rod and its bearings must, of course, be properly insulated from the con-

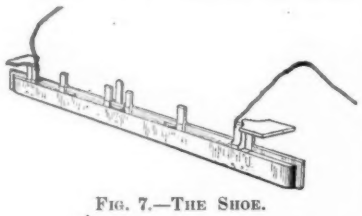

FIG. 7.—THE SHOE.

tact box. When no car is passing, the brush is out of all electrical connection with the current conductor, but when the shoe on the car reaches the arm projecting into the conduit, it swings it to one side, bringing the brush on the rod into contact with the tongues fastened to the conductor, and the current passes to the motor on the car. As soon as the shoe on the car has passed the box, a torsion spring forces the rod back into its normal position, and that box is dead. The box is filled as far as it can be without interfering with the movement of the brush with solid paraffine, and above that with "transil oil." This makes excellent insulation. Of course, the spindle, which at times becomes "alive," and its bearings are thoroughly insulated from all parts of the box and cable. Nothing can be better than an insulated cable, covered throughout its entire length with a highly resisting material, and at the points where current is supplied to the car an insulation practically infinite.

No accident to persons or animals appears possible with this system. To avoid sparking within the box, the ends of the shoe are made of insulating material, thereby establishing mechanical contact within the box before the metallic portion comes into contact with the arm, and also holding the inside contact after the current ceases to flow to the motor. This is an important feature, for without such an arrangement the brushes would soon burn out, the oil become carbonized and the boxes useless.

Thus far I have described the box that we used at the Island, but it has long since been consigned to the usual receptacle for the rejected productions of progressive inventors. It did its work and did it well; it pointed the way to better things, and we have several forms of box, entirely obviating the defects in the first. The number of working parts has been reduced, and we now have the device brought down to its lowest terms. I regret that it is not possible for me to show these improvements, but patents have not been obtained on some, and on others not yet applied for.

As a guide for future investigators, I will enumerate the best features and the defects of the old box, as I understand them. 1. Its insulation was excellent, that is, the theory of its insulation was. But oil insulation is in many cases a fraud, a deception and a snare. The best oil insulation is not so good as that of air containing 80 per cent. of moisture. Oil and water, perhaps, won't mix, but oil will attract moisture, and the two will make an emulsion that will cause the investigator much sorrow and mental anguish. Ordinary paraffine oil, even the highest grades obtainable, contains a great deal of water, which, in a device like this, will cause disastrous short-circuiting. Transil oil seems to be the best for the purpose. At Coney Island, before we adopted transil oil, our boxes would go wrong, in spite of all we could do, and we only discovered the trouble by putting some of our oil in a bottle to settle over night, and in the morning found an abundance of water in the bottom. Solid paraffine is the only substance that we found capable of withstanding the action of paraffine oil, and it must be the refined variety, such as is sold in hard, white cakes. Its use even was discarded, for when the water would work down the spindle through our imperfect stuffing box, the solid layer formed a bed for the moisture to rest upon, and being close to our brush, it short-circuited the box. It is better to let the moisture settle to the bottom of the box, out of harm's way. I don't think oil should be used on account of its insulating properties, but for keeping the working parts from rusting. 2. Our old box was made in several parts (a mistake, remedied in our new one-piece box), the joints required planing, an expensive operation. Paraffine is difficult stuff to hold, going through almost everything. In the joints we used oil paper, screwed them together as tightly as possible, but the oil softened the paper and the boxes leaked. This we remedied by painting the joints with "Insullac," which withstood the oil excellently. 3. Our stuffing box was a crude device, and did not, in many cases, keep out the water; but this is a simple mechanical affair remedied in our new boxes. 4. A torsion spring is not so good as a straight one, nor so reliable in its action. 5. We had a short brush in our box, when a long one should be used. Flexibility and sure contact are thereby secured. 6. It was a mistake to have the two upwardly projecting tongues; one contact is the thing, and the brush always resting against it when the shoe touches the arm. Otherwise there will be a break on reversing and consequent "frilling" of the brushes, with carbonization of the oil. 7. To make an oil-tight joint between the cable and the box was almost an impossibility. We taped the cable where it entered the box, but when it was tightened up there was often contact between the lead covering and the box. 8. The box is too large. 9. Great care must be used in selecting and laying the cable. A slight defect gives leakage; this decomposes the alkaline earths; chlorine and caustic soda are perhaps produced, and the cable eaten away. Every joint must be carefully made and carefully sealed. Some one may say that it is impossible, but I answer it is the duty of the supervising engineer to see that it is properly done. If anyone thinks this cannot be done, he is not my ideal engineer, and certainly does not want to meddle with electric conduit railways. These are the defects, but we have cured them all in our new system. The excellent principle of the old box has remained untouched by long experiment, the laterally yielding arm being the only form likely to answer the purpose.

I add the report of Mr. Stevenson upon our "mud test."

THE BRUSH ILLUMINATING COMPANY, OF NEW YORK.

NEW YORK, September 21, 1893.

ALBERT STETSON, ESQ., 50 Broadway, New York City:

DEAR SIR—In accordance with your request of yesterday, *in re* tests made by me on the new electric conduit and car at Coney Island, I beg to submit the following report:

The insulation resistance of the whole line, when car is not in circuit, equals 63,500 ohms.

The insulation resistance of line, with shoe of car and adjacent switch boxes in contact with shoe submerged in water, equals 380 ohms.

Electro-motive force of power circuit equals 353 volts; 353÷380=.926 ampere loss.

Seventy-five feet of conduit were pumped up full of water previous to the test.

With Weston ammeter the reading was hardly discernible.

The loss on boxes tested by Weston voltmeter showed nothing.

The resistance test was made with Thomson tripod galvanometer, and by comparison with standard resistances.

From the above figures the following result is arrived at:

As 75 feet of the conduit were submerged, this would include 12 boxes. Therefore, it is safe to assume that the loss was only on those boxes, as several of the dry boxes tested showed no leakage.

Then, as the loss on the circuit with boxes all open (that is electrically) was .0058 amperes, equaling .0027 horse-power, the loss on each box equals $\frac{1}{12}$, which amounts to .000483 amperes, and which equals .000223 horse-power. It, therefore,

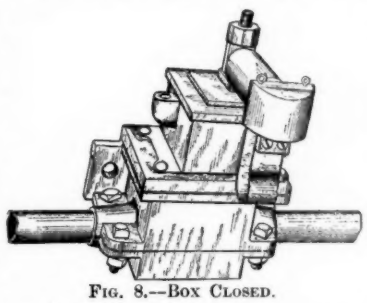

FIG. 8.—BOX CLOSED.

would take 4,484 boxes entirely submerged to give a loss of 2.113 amperes or one horse-power, and, as the boxes are six feet apart, this equals 5.092 miles.

The car standing with shoe entirely submerged, and the two adjacent boxes with the switches turned on, showed a loss of .926 amperes, equaling .438 horse-power. And, as the car takes about 12 amperes, this equals 5.68 horse-power on ordinary track. This shows that it loses 7.96 per cent. of its power when so placed; or, expressed differently, 13 cars placed in the same condition would lose about the same amount of power which it takes to drive one car. (Signed.) E. W. STEVENSON,
Electrician, Brush Illuminating Company.
[Affidavit as to correctness attached.]

These are submitted as very remarkable and satisfactory figures, but I mistrust that we are entitled to more, as there were five lamps burning on our car, and their consumption of energy must have been charged up as leakage on the line.

Now, although our conduit has withstood such tests, it must not be supposed that mud should be allowed to accumulate there. It should not and the cleaner the conduit can be kept the better. At frequent intervals mud holes should be placed, and each car should carry a stiff brush to sweep into these any accumulations of mud, snow and water.

The question has often been raised as to whether snow and ice would clog up the conduit and stop the car. The experience with the Cleveland Bentley-Knight road shows that snow did not stop a road with a bare conductor in the conduit, and it certainly could not affect ours. You must drain the conduit, and during such weather as the conduit might get, if left to itself,

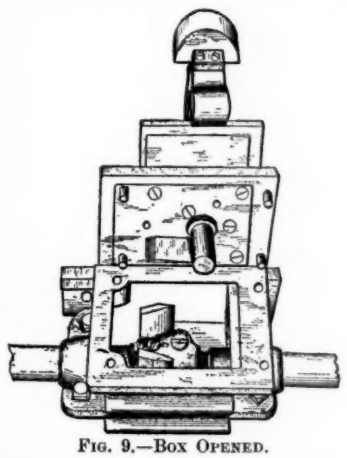

FIG. 9.—BOX OPENED.

frozen up, it may be necessary to run a car over the track at intervals all night. But this only would be required once, say, in a Winter.

I believe that our road has solved the question of conduit traction. I have not meant in my review of other systems to be in the least unjust to other workers in the same field. I only take my stand on other well-established principles, keep strictly to the laws of nature and electricity, take our climate as it is and our streets as we find them, and I assert, without fear of successful contradiction, that any road to succeed must be laid down practically on these lines.

To sum up, then, the objects of such a system are: To remove from the streets of our cities and large towns the unsightly structure that the trolley construction demands; to dispel all chance of injury to persons and animals; to present no such lightning conductor as the trolley line forms; to offer no obstacle to the work of the firemen, in case of a conflagration; to remove all risk of fires being set by the electric current, as frequently takes place with the trolley; to avoid corroding action on water and gas pipes and the iron foundations of buildings. Finally, to furnish all the advantages of electric traction without any of the present attendant evils.

The main advantages of such a system are evident, but there are others. The car runs backward as well as forward, and handles as nicely and easily as a locomotive. There is no trolley wheel to slip off the wire, depriving the motorman of his power at the very time he needs it most to prevent accidents.

I have endeavored to present our system to you as it is. I have not in any manner exaggerated its advantages, nor do I speak as one who is led to be enthusiastic over something that is new. I am too experienced in such matters, and have seen too many new things spring into momentary notoriety, only to sink into oblivion. I believe in the practicability of the electric conduit, and believe that you can profitably devote your attention to the forwarding of that method of electric traction.

DISCUSSION.

The President: Discussion of this very interesting paper of Mr. Stetson is now in order.

Mr. Nelson W. Perry: I would like to ask Mr. Stetson what provision is made for rounding curves, both as to the shoe itself in its entirety and as to the insulated portion of the shoe; if there is provision made so that it will go into those guides on a curve of a given radius, how do you provide for its going into those same guides if the curve is of a different radius, and also in getting around any curve with your shoe nine feet in length?

Mr. Stetson: I will try to make that plain. Suppose this (illustrating) to be a platform, such as I tried to show on the screen. At the end of our shoe we have a flat piece which rests on the platform. It may shove back and forth. When your car takes a curve, if it is going one way, the shoe will glide along on this platform; if the other way, on the other platform. The shoe is so flexible that it will bend up double. At the end of the shoe, in the insulated portion, there is a slot cut, and in that there is a nut, which allows it to play either way. The nut working in the insulated portion permits flexibility. If it was not for that, if it was a straight piece, the metallic portions would bend in the middle and would meet, but you allow a slipping motion of the nut in the slot. On the end of this shoe there is a rod projecting upward and fastening on to the platform; then this slides in transversely with the bottom of the car. That is all the support that it has. It cannot get out because it must follow the conduit slot. It is supported at both ends. When the car takes a curve the support of your shoe moves along either to the one side or the other of the platform.

Mr. Perry: Supposing you have a shoe like that (referring to a sketch on the blackboard). Your shoe has to go into these two contacts. Now, the shoe comes along here. How is it diverted from the tangent to the curve so as to properly make contact with the next switch?

Mr. Stetson: I see. We had a number of guides so that it must take very nearly this circle and follow it. When your shoe is going along it would naturally continue to move on a tangent; but the guide forces it around the curve.

Mr. Perry: Supposing you had provided for a curve of a certain radius and you come to a curve of another radius. How would the different diversions be accomplished?

Mr. Stetson: It would be just the same. The shoe will bend right up in the middle on your guides, and thus confine it absolutely to the conduit slot. The course of the shoe is absolutely controlled by the conduit slot.

(To be continued.)

A Goat Eats Trolley Wire.

The trolley of an East End electric car got tangled in one of the cross-overs and tore down a live wire, which squirmed about on the asphalt, hissing like a snake, and causing the spectators to flee in terror. At last the wire came to rest, and attention was diverted from it momentarily, but called back again when a newsboy cried out: "Gosh, look at the dead billy goat! He's swallowed the wire!"

And, sure enough, he had. While the vulgar mob had ignored the wriggling wire, the gentle goat, wandering out of the alley behind the college building, where a boy had tied him with a rope, caught sight of the wire and thought to eat a few feet of it to settle the springy rope meal. He had gotten about two feet swallowed when the current pulsated through it again and Billy fell dead.
—*Cincinnati Times-Star.*

Annual Report of the Edison Electric Illuminating Company, of New York.

THE FINANCIAL OPERATIONS OF A YEAR OF A LARGE LIGHTING COMPANY.

The annual report of this company for the year ending December 31 was issued last week. Following is given a comparative showing of the income account and the balance sheet:

	1893.	1892.	Changes.
Gross earnings ..	$1,193,338	$942,575	Inc. $250,763
Operating ex.....	527,311	385,494	Inc. 141,817
Net	$666,027	$557,081	Inc. $108,946
Other income	28,221	20,446	Inc. 7,775
Total	$694,248	$577,526	Inc. $116,722
Legal ex. and taxes.	112,570	102,389	Inc. 10,181
Net.....	$581,678	$475,137	Inc. $106,541
Interest	144,820		
Balance.....	$436,858		
From investments	23,964		
Total.....	$460,822		
Dividends.....	451,174		
Surplus.....	$9,648		
Balance, 1892.....	47,630		
Total.....	$57,278		
Old acc. written off	14,484		
Surplus.....	$42,794		

The condensed balance sheet is as follows:

	1893.	1892.	Changes.
Licenses Edison patents.....	$3,020,000	$3,020,000	
Real estate, etc..	7,335,682	6,304,666	Inc. $1,031,016
Stock of other companies. ...	1,184,700	....	Inc. 1,184,700
Customers'acc'ts	156,296	143,796	Inc. 12,500
Acc'ts and supplies	70,133	89,052	Dec. 18,919
Cash..... ...	189,750	33,736	Inc. 156,014
Total	$11,956,562	$9,591,251	Inc. $2,365,311
Liabilities.			
Stock outstanding.....	$7,938,000	$6,100,000	Inc. $1,838,000
Bonds outstanding.....	3,562,000	3,100,000	Inc. 462,000
Bills payable.....	157,328	136,838	Inc. 20,490
Dividend Feb. 1..	119,046	66,567	Inc. 52,479
Accrued interest.	59,366	51,667	Inc. 7,699
Reserve fund. ...	69,668	82,356	Dec. 12,688
Sundries	8,359	2,532	Inc. 5,827
Profit and loss surplus.....	42,793	51,291	Dec. 8,498
Total.....	$11,956,502	$9,591,251	Inc. $2,365,311

The returns of the business since 1889 are:

	Gross.	Net.
1890.....	$488,595 83	$229,076 80
1891.....	675,505 43	347,228 63
1892.....	963,021 25	475,137 61
1893.....	1,221,560 87	581,678 72

	1890.	1891.	1892.	1893.
Number of customers.	1,698	2,875	4,344	5,154
Number of lamps, 16 candle-power.....	64,174	94,485	142,492	192,691
Number of motors, horse-power.....	607	2,000	3,807	5,529
Number of arc lights.	254	841	1,637	2,538

Estimating each horse-power motor and each arc light as equal to ten 16 candle-power lamps, the present installation is equal to 273,361 lamps. These figures show that the gross earnings have increased 27 per cent. and the net earnings 22 per cent. over 1892; the ratio of net to gross being 48 per cent., or about the same as in 1892.

President Trask's statement follows:

In view of the financial distress during the last eight months, resulting in greater economies in the use of electric light, as in everything else, your directors feel that the results of this company's business for the year are very satisfactory, especially when it is considered that a large part of the new capital, which has been invested this year, has gone into construction which has not yet developed its earning capacity by actual operation.

A somewhat decreased use of light per customer has been more than offset by a large increase in the number of new customers; in fact, the number of applications has been in excess of our ability to supply. This inability was partly due to the fact that last Summer, during the extreme monetary stringency, your directors felt bound to exercise great care in accepting new business, since its acceptance would have necessitated additions to our plant, which, however desirable in themselves, were not then expedient, as no funds had been provided for such purposes. Of late, the company has resumed its policy of taking on all new applicants, thus securing a present increase of revenue, with the certainty of a still further increase as soon as financial conditions shall improve. The fact that even in the extreme time of the depression through which we are passing, the demand for our light exceeded our capacity to supply it, is a forcible illustration of the soundness of our enterprise.

In the last report your directors referred to the necessity of completing the Elm Street Station, and adding to the plant. In order to provide funds for these purposes, as well as to carry out contracts made in connection with the acquirement of a large interest in the Manhattan and Harlem Companies, also referred to in last year's report, a plan was devised last Spring looking to the retirement of the then outstanding bonds of the company by conversion into stock, which would have enabled the company to create a new non-convertible bond at a lower rate of interest. In pursuance of this plan authority was obtained from the stockholders to increase the capital stock to provide for conversion and for the general purposes of the company.

The financial stress which began early in the Spring limited the offerings of bonds for conversion, although $688,000 bonds were exchanged. As contracts for the new work contemplated had been made early in the year, before there were any signs of the coming storm, an entire change of plan was necessitated later on, owing to the changed financial conditions. Such change was, however, satisfactorily made.

Your directors decided that it was wise to sell some of the stock which had not been called for in exchange for bonds, and later obtained authorization from the stockholders to issue the balance of the bonds available under the mortgage ($1,750,000 in all), $1,000,000 were sold and paid for in the year just closed, and the remainder are under option. These bonds are sufficient in amount to provide funds for the requisite construction purposes of the company, including, as closely as can be estimated, nearly, if not quite, all the needed additions to the plant for the year now beginning.

While your directors are convinced that the true interests of the company require continued development as fast as may be consistent with business prudence, yet they feel that the same prudence now demands that the additions of the present year should be somewhat more restricted than usual, and should be made only where they are likely to return the quickest revenue. In this way the existing plant will be utilized to the best advantage, and it is fully believed that the profits of the company will be increasingly satisfactory to all concerned.

The construction of the Elm street station has been pushed forward, the exterior having been in the main finished. The permanent boiler room has been in use for some weeks, and the upper floors, including those intended for the offices of the company, will be finished for occupancy during the early part of the present year.

The new 2,500 horse-power generator was installed at the close of last year, and the temporary plant in the yard next to the Elm street station will soon be discontinued and put to other uses.

For a part of 1893 the old Pearl street station was not in use, but during the heavy load of this Winter it has been used to supplement the Elm street station. It is hoped, however, that we shall be able to discontinue it entirely during the year now begun. These changes will permit the concentration of all of the company's generating apparatus downtown in the one large station, with the exception of the small subsidiary plant at the Produce Exchange annex, thus completing another and most important step toward an increased economy in operation.

The equipment of the Twenty-sixth street station has been completed to its fullest capacity during the year, and the generating apparatus at the Thirty-ninth street station has been increased.

The underground extensions of the year have been confined chiefly to Fifth avenue, from Sixtieth to Seventy-ninth streets and the adjacent blocks to the east, resulting in a large increase of installation in that important residential quarter; to the development of feeders and mains where elsewhere necessary to supply new business, and to establisbing the system in streets included in the new paving plans of the city authorities.

The policy of your directors in discontinuing the business of installation work inside of buildings, as referred to in the last report, has been thoroughly justified by the events of the year, over 100 different contractors having made satisfactory installations in connection with our system. It is gratifying to note that half of this work has been done by the New York Electric Equipment Company, to which the old wiring department of this company has been transferred. Your company has, however, been most careful to hold an even hand among the several contractors, so that it should not be accused of giving one an advantage over another.

The careful oversight given to the affairs of the Manhattan Electric Light Company, Limited, and the Harlem Lighting Company, in which the company became interested, as stated in our last report, has resulted in a satisfactory development, those corporations both having shown an increase of earnings during the year sufficient to justify the expectations of the ultimate payment of satisfactory dividends. The actual and contingent obligations existing in connection with the Manhattan and Harlem purchase are now reduced to about $400,000, maturing at various dates from the Spring of 1894 to the Winter of 1894-1895. It will also be desirable to make a moderate expenditure during the year in enlarging the Manhattan plant. To meet all these outlays, your company holds about $600,000 of the Manhattan Company's first mortgage bonds, which it will, perhaps, be expedient to guarantee and dispose of, from time to time, as opportunity shall offer. A special meeting of the stockholders will probably be called later on to consider this matter.

The courts have confirmed the Edison lamp patents by numerous decisions during the year, as a result of which arrangements have been made to collect considerable sums for the past use of infringed lamps, as well as to provide for the payment in the future of royalties for the use of the Edison lamp.

At the annual meeting held on Tuesday, January 16, the old board of directors was re-elected, except that W. E. Glyn takes the place of Director Henry, who has resigned.

OUR CHICAGO LETTER.

Mr. J. J. Dickey, of Omaha, Western Superintendent of the Western Union Telegraph Company, is arranging to build a telegraph line to Cripple Creek and Florence, Colorado.

For Your Library.—The Central Electric Company, 118 Franklin street, Chicago, are favoring their friends with a handsomely bound monograph on slow-speed direct-current motors.

A Desk Pad.—Mr. C. E. Bonnell, Craigin, Ill., will send a desk calendar pad to every reader of the ELECTRICAL REVIEW, free of charge, on receipt of a postal card giving street address, provided the postal is received before the supply is exhausted.

The Rice Machinery Company, 170 South Clinton street, Chicago, will send to interested parties a description of their new device for moving friction clutches into and out of gear. This device is adapted for separate foundations, for independent standards and for floor stands.

Stocks.—The following range in electrical stocks occurred during 1893: Central Union Telephone Company, 45-58. Chicago Arc Light and Power Company, 104½-118½. Chicago Edison Company, no variation from 200. Chicago Telephone Company, 190-210. North Chicago Street Railroad Company, 147-300. West Chicago Street Railroad Company, 100-225.

Armour Institute commenced the second term of its existence with nearly 1,000 students, and applicants for admission amounting to over 2,000 are unable to obtain entrance on account of the lack of room. All of the old students have registered. The institute now offers a complete four years course in chemistry and architecture in addition to the complete course in electrical, mining and mechanical engineering.

The National Electric Company.—Und r the firm name of Horne & Martin, Fred. W. Horne and John L. Martin, have been appointed general sales agents of the National Electric Company of Eau Claire, Mr. Ide's new company, and have opened offices at 505 Home Insurance Building, Chicago. Both these gentlemen are well known from their long connection with the Excelsior, the Thomson-Houston and the General Electric companies.

The Star Electric Lamp Company, No. 120 Michigan avenue, are now furnishing the new "Sunbeam" incandescent lamp with luminous vapor, which is said to be much superior to both vacuum and gas lamps. It is said that the experiments with luminous vapor give promise of great improvements in the quality of incandescent lamps, which will make them much superior to vacuum lamps which have certain positive limitations.

The Chicago Power Supply Company has laid about 16,000 feet of a four and a half inch pipe on Clinton, Union, Halsted and adjacent streets, and will shortly begin to supply compressed air for power purposes. It is understood that these pipes may also be used for stringing telephone and electric light wires, making the franchise a valuable one, even though the conditions include the payment of five per cent. of the gross receipts to the city treasury.

A Conduit Department.—On account of the rapid increase in the demand for first-class interior conduit service, and owing to the National Board of Fire Underwriters indorsing the action of the local board compelling the use of interior conduit in all buildings, the Central Electric Company have found it advisable to create a conduit department. Mr. C. G. Burton has been placed in charge of this department, and having a wide experience in installing conduits under varying conditions, and an extensive acquaintance among architects, success is practically assured from the start.

Armour Institute's magazine for January, contains an interesting description by Mr. C. O. Billow, of the oil fuel plant at the World's Fair, together with cost of operation and maintenance. Mr. Billow states that 32,315,964 horse-power [hours were developed at a cost of 6.3 mills per standard horse-power, 5.7 mills being the cost of the oil consumed, and .6 mill the cost of handling, including all salaries. This remarkable showing will attract attention and in anticipation of criticism, Mr. Hazelton, with Mr. Billow's consent, framed a brief and clear reply from the standpoint of the coal user. Therein references are given under which an indicated horse-power hour has been developed in various sections of the country for less than 4½ mills, the first cost of coal ranging from $4 to $1.50 a ton.

"London Truth" intimates that care is not exercised in guarding the exhibits and there are few facilities afforded in shipping them. To this charge the Chicago *Tribune* replies: "There is no doubt that every British or other foreign exhibitor will get his goods home safe if he properly labels them and pays the freight. There was some delay in getting packing cases to the exhibitors after the Fair, because of the physical inability to deliver several hundred thousand boxes in a day, in accordance with the wish of 70,000 exhibitors. Practically all of the British exhibits have been shipped. An adequate fire department and guard service have been maintained since the close of the Exposition. There are 200 guards now protecting the remnant of exhibits in Machinery Hall, Manufacturers, Fine Arts and Mines Buildings. The Exposition company has $1,700,000 in its treasury and holds itself responsible for the custody of exhibits remaining in the buildings." The stockholders, 28,000 of whom are in Chicago, will shortly be paid a 10 per cent dividend. $5,600,000 was subscribed by individuals and companies.

President Charles T. Yerkes still intends to equip the cross-town branch street car lines with electricity if the council will permit. "If the council does not care to let us put in electricity, we shall run along just as we are running on the cross-town branches and save the money it would cost for electrical equipment." Explaining the attitude of his company towards the residents tributary to the Evanston Avenue Line, Mr. Yerkes says: "We offered to let the electric line come down to the cable over our Evanston Avenue Horse Car Line. To do that they had to get the consent of property owners before they could put in electricity. The property owners thought that they would compel us to extend the cable out to Graceland avenue by refusing to let the electric line come down the barns. I might as well try to make you go out to buy a new coat to suit my notion. The electric line is only a feeder for our road and all of its business is through travel for down-town. For that reason it is of no great value to us, because its passengers fill the cars during the rush hours, ride the whole length of the line and to that extent deprive us of short-distance travel." Mr. Yerkes believes that it is impossible to carry passengers more than five miles and make it pay.

Chicago, Jan. 13, 1894. F. DE L.

TELEPHONE CHAT.

Atlanta, Ga., telephones now operate on a complete and perfect underground system.

Coin actuated telephones have been added to the Salt Lake City system of the Rocky Mountain Bell Telephone Company.

The Southern Massachusetts Telephone Company have prepared plans for erection of a building in Brockton to be used as a telephone exchange.

The new line of the Northwestern Telephone Company is now completed from St. Paul to Winona, Minn., with the exception of the distance from Read's Landing to Wabasha, where the new line will be put in in the Spring.

It is reported that the Citizens' Mutual Telephone Company, using the Harrison patents, will have a plant in operation in Decatur, Ill., early in March. It is claimed that over 500 subscribers at $2 a month each per 'phone have been secured.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week.

New Telephone Companies.

HILLSBORO, N. H.—The Contoocook Valley Telephone Company has obtained a charter and effected an organization with the following officers: S. H. Baker, president; M. H. Felt, treasurer; B. K. Webber, clerk; S. H. Baker, M. H. Felt, G. W. Lincoln, Ira Jackman and Sillman McClintock, directors.

Electric Light and Power.

ROCK ISLAND, ILL.—The Brush Company, of Cleveland, O., has sold its plant and franchises for electric and gas illuminating purposes here to the People's Power Company, of this city, for $225,000. The purchasing company thereby gains control of the illuminating business of the cities of Rock Island and Moline.

BALTIMORE, MD.—The Suburban Electric Light and Power Company; capital, $20,000. Incorporators, James McAvoy and others.

BASTROP, TEX.—The City Clerk can give particulars regarding an electric light plant to be erected here.

CHICAGO, ILL.—Suburban Electric Light and Power Company, Chicago; capital, $15,000. Incorporators, A. F. Dexter, William Phillipson and M. C. Carr.

PITTSBURGH, PA.—An application for a charter has been made by the Hazelwood Electric Company, to supply light, heat and power.

PEORIA, ILL.—Articles of incorporation of the Elmwood Electric Light Company were filed recently with the recorder. The capital is $30,000, and E. P. Brown, Laura S. Brown and E. L. Brown are the incorporators. The company is organized to run and operate a steam electric power station, and to deal in general and to buy and sell electric currents and apparatus, and to furnish heat, power and water.

Business Troubles.

MARTINSBURG, W. VA.—S. W. Walker has been appointed receiver of the Martinsburg Edison Electric Illuminating Company, on the application of John B. Wilson and others.

KINGSTON, N. Y.—Judge Brown, of Newburg, has appointed Joseph Morchauser, of Poughkeepsie, receiver of Burhans Van Steenbergh, proprietor of the New Platz Electric Light Company, the New Platz Water Company and the New Platz and Highland Electric Railroad Company. The water company has a capital of $25,000, with bonded indebtedness of the same amount. The capital of the electric light company is $15,000, indebtedness same; and the electric railroad has a bonded indebtedness of $145,000 and $40,000 of issued stock.

ROME, GA.—The Rome Electric Railway is in the hands of a receiver.

PADUCAH, KY.—The property of the Eastern Telephone Company, in this city, is in the hands of a receiver, Oscar Kahn being appointed by the Circuit Court. It was not the result of financial inability on the part of the company, but rather of an old suit to which the company failed to give proper attention.

NEW YORK CITY.—On January 18 a judgment for $2,018.74 in favor of A. Herkovitz was recorded against the New York Electrical and Development Company.

NEW YORK CITY.—The Equitable Life Assurance Society of the United States has secured a judgment for $940.73 against the American Electro Matrix Company.

NEW YORK CITY.—A motion for the appointment of a receiver of the property of the Thomson-Houston Electric Company, of New York, a local illuminating company, was made on January 18 to Justice Barrett in the Supreme Court, Chambers, at the instance of Henry R. Worthington, a judgment creditor of the company, for $1,576.53. This judgment was secured against the company on November 8 and has not been paid. It was, therefore, asked that the property of the company be sequestrated and the proceeds be distributed among the creditors, and it was urged that a receiver be appointed temporarily. Henry Winthrop Gray was appointed receiver and his bond has been fixed at $50,000.

New Electric Railways.

ST. LOUIS, MO.—The Merriam Park, Rosedale and Kansas City Electric Railway Company, of Merriam, Johnson County, Kan. The directors are A. A. Peterson, J. Wilson and G. C. Branham, of Merriam; E. G. Bartberger, Dr. R. Matney and Wm. D. McLaughlin, of South Park; C. W. Brown, of Kansas City; and B. F. Hollenbeck, of Shawnee. The capital of the company is fixed at $50,000.

UTICA, N. Y.—The United States Headlight Company has been incorporated with a capital of $1,500,000. The company is to manufacture and sell locomotive headlights, other headlights, electric and otherwise.

ST. LOUIS, MO.—The A. C. Wolfram Electric Company; capital, $20,000. Incorporators, Adam C. Wolfram, T. John Wolfram and H. William Buecker.

DETROIT, MICH.—Articles of association have been filed by the Fisher Electrical Manufacturing Company. They are capitalized at $50,000, fully paid in. The stockholders are Christian H. Meday, 1,200; Christian H. Meday, trustee, 3,513; William E. Reilly, 85; Henry H. Meday, 50; Rose E. Peters, 150; Frank E. Fisher, 1; Hiram Marks, 1.

DETROIT, MICH.—Sealed proposals will be received at the office of the Public Lighting Commission, Hammond Building, until Tuesday, January 30, 1894, at four o'clock, P. M., for furnishing all the labor and materials for the construction of the necessary engines, boilers, dynamos and arc lamps for the public lighting plant to be erected by the City of Detroit, in accordance with the specifications on file in the office of the Public Lighting Commission.

Increase of Capital.

RACINE, WIS.—Street Railway Company, of Racine, filed amendment increasing the capital from $150,000 to $200,000 and providing for the extension of the line to Mount Pleasant and Caledonia.

COLUMBUS, O.—The Oberlin Gas and Electric Company has increased its capital from $20,000 to $30,000.

BROOKLYN, N. Y.—The New York and New Jersey Telephone Company has increased its capital from $2,535,000 to $3,500,000.

New Manufacturing Companies.

NEW YORK CITY.—The Black & Boyd Manufacturing Company to manufacture gas and electric lighting fixtures in New York city; capital, $25,000. Directors, John A. Black, W. P. Brice, L. Plant and Herman Plant of New York city.

JACKSON, MISS.—Weaver Electrical Company to manufacture electrical and telegraph instruments; capital, $20,000. Incorporators, A. P. Weaver and others.

OBITUARY.

DEATH OF G. B. PRESCOTT.

George Bartlett Prescott, one of the pioneers of electrical research, died of heart failure at the Buckingham Hotel, New York city, on January 18, after an illness of two weeks. Mr. Prescott was born in Kingston, N. H., on September 16, 1830. He received his education principally at private schools in Portland, Me., and began in 1846 the study of electricity. He learned the art of telegraphy soon after its invention by S. F. B. Morse, and from 1847 to 1858 was manager at New Haven, Boston, Springfield and other telegraph offices, after which he was superintendent of the American Telegraph Company, and later on superintendent of the Western Union Telegraph Company. He was electrician of the International Ocean Telegraph Company from 1873 to 1883, and during that time made a visit to Europe, and as a result introduced into the United States many improvements in the telegraph. For several years he was one of the vice-presidents of the Gold and Stock Company, and also one of the incorporators of the Metropolitan Telephone and Telegraph Company.

Mr. Prescott was president of the Manhattan Telegraph Company and the American Speaking Telephone Company. He patented several inventions in connection with the telegraph, and was a joint owner with Thomas A. Edison in the quadruple patents in this country and in England. He introduced in 1870 the duplex telegraph, in 1874 the quadruplex telegraph and in 1876 the use of pneumatic tubes in the transmission of messages.

While manager of the Boston office in 1852 he made the discovery that the aurora borealis is of electrical origin, and published an account of the discovery. On various occasions he removed the batteries from the telegraph wires and operated the latter by means of the current induced by the aurora. These discoveries attracted much attention throughout the world, and his description of them was reproduced in all the leading scientific journals of Europe and America.

Mr. Prescott was the author of the following works on electrical subjects: "History, Theory and Practice of the Electric Telegraph," "Electricity and the Electric Telegraph," "The Speaking Telephone," "Dynamo Electricity," "Bell's Electric Speaking Telephone: Its Invention, Construction, Application, Modification and History," and "The Electric Telephone." Mr. Prescott leaves a widow and one child.

The death is announced of Prof. Heinrich Hertz, the eminent scientist, at Bonn, Germany.

The Walker Manufacturing Company.

Since the announcement that the Walker Manufacturing Company had decided to add an electrical department to its immense plant for the manufacture of street railroad dynamos, motors and other electrical transmission machinery, work has progressed quietly but rapidly. The first machines to be placed on the market are now nearing completion, and within a short time the company will be in active business in this line of work.

It was predicted at the time of the announcement that the Walker people would prove an unusually strong factor in the electrical field, and this prophecy is borne out by the fact that business has already been offered the company, both from eastern and western roads. Judging from recent reports, there appears to be no doubt in the minds of those in any way interested of the immediate and unqualified success of the new machines. To all who have seen them the general designs are eminently satisfactory, and the rapid progress of the work has called forth the most favorable comments. The closest attention has been paid to mechanical detail. The improvements suggested and already carried out are considered by experts who recently visited the Walker plant to be a distinct advance. This verdict was rendered only a few days ago by prominent railway men and future purchasers who visited the company shops to note the progress of the work. One especially noticeable feature is the ease and facility with which the work is being done. There have been no unusual delays in assembling the various parts, and fewer annoyances in construction than generally attends the first output.

The "Wheel-type" idea has been followed in the designs for generators, and this plan will prevail throughout. So far it has been impossible to obtain details of construction, as the company's officers are not yet ready to give out specific information. Within a very short time, however, the ELECTRICAL REVIEW will give a full description of the new machines, illustrated with cuts.

A Lecture by Dr. Colton, the Inventor of the First Electric Locomotive.

In this city on Tuesday evening, January 16th, Dr. Colton, celebrated as the discoverer of "laughing gas," delivered a most interesting lecture on assorted phenomena in physical science, including a mention of what is declared to be the first engine ever moved by electricity.

Prof. R. O. Doremus introduced the lecturer of the evening with a delightful speech, in which he complimented the venerable inventor in the most highly flattering yet deserving terms. He spoke of him as a remarkable old man, in the eightieth year of his age.

Dr. Colton then followed with a rather brilliant series of chemical and philosophical experiments, ending with an illustration of the working of his electric engine.

In 1847, three years after he had discovered the applications of laughing gas to dentistry, he made a tour of the United States, lecturing on various subjects and exhibiting the locomotive engine which was driven around a circular track six feet in diameter, electricity being the motive power. As an authentic corroboration of this statement the doctor read an extract from the Louisville *Journal*, dated October 20, 1847, in which appeared the advertisement for his lecture and the following editorial notice:

"Dr. Colton's lecture to-night embraces a variety of entertaining subjects. His exhibition of the electro-magnetic telegraph is enough of itself to cause the house to be crowded. In additon to this he will exhibit the double reciprocating engine and circular railroad, with a series of brilliant philosophical experiments. Such a combination of attractions cannot fail to draw a crowded house."

Now that the subject, "Who was the first one to invent the electric locomotive?" has become prominent in public eyes, this simple mechanism built with no intention of practical application or little idea of future possibilities, becomes of importance.

The device consists of a simple reciprocating armature, which is attracted in turn by two vertical electro magnets. Current is obtained through the tracks, and an ordinary commutator device on the axle sends the current first into one electro-magnet and then into the other. The movement thus obtained is transformed by means of a crank, a movement of revolution thus being set up.

Little idea did the Doctor have when he built this homely engine that it was destined to be possibly first in the grand series which is gradually but surely attaining mechanical and electrical perfection; little did he think that the populace of a great city, such as Brooklyn promises to be, would some day have all their surface cars operated by electricity.

Many minds, however, have been at work on this problem, and solution after solution has been obtained. The trolley roads, as they now exist, are susceptible of many improvements as yet, but while the systems grow in breadth and expand throughout this great country we should not forget the first engine designed by Dr. Colton, which in all likelihood is the seed from which the numbers of electric street railway plants have sprung.

An electric railroad is projected to connect Hartford and Unionville, Conn.

KINDRED INTERESTS

The Shultz Belting Company, of St. Louis, through its New York manager, Mr. A. B. Lawrence, is sending out a neat calendar for 1894.

The Bolgiano Water Motor Company, Baltimore, Md., is receiving daily a large number of testimonials commending its "Little Giant" water motor for light work.

The Sebastian-May Company, Sidney, O., announce that their new catalogue, No. 7, is ready to send to all those who want lathes, grindstone frames, emery grinders, drill presses, planers, shapers, chucks, etc.

Diana.—The Goodrich Hard Rubber Company, Akron, O., has displayed its usual good taste in the artistic annual it is sending to its customers. The coloring is richly harmonious and the face is human and lovable, not idealized.

The R. Thomas & Sons' Company, East Liverpool, O., manufacturers of hard vitreous porcelain electrical supplies, have sent us the best and most complete catalogue of porcelain goods that we have ever seen. If you are interested write for one.

The Metropolitan Electric Company are moving into their new building, 186 to 188 Fifth avenue, Chicago, where they will have ample store and office facilities, besides warerooms, and are getting in a large line of staple goods to enable them to take care of all orders without delay.

The Berlin Iron Bridge Company, of East Berlin, Conn., are putting the roof on a building for the United States Government, at Fort Wadsworth, N. Y. The building is 41 feet wide and 231 feet long, the roof being made entirely of iron—iron trusses covered with corrugated iron.

N. S. Large & Son, have established a complete plant at 321 Chestnut street, Philadelphia, for manufacturing electrical supplies. Model, experimental and repair work will be given especial attention. This company has a new knife switch which possesses great merit, and they expect to have a new catalogue ready in a short time.

Queen & Company, Incorporated, Philadelphia, make a special form of electro-dynamometer, which they have supplied largely to central stations and manufacturing concerns, for use as a standard ammeter in measuring both direct and alternating currents. The fact that instruments built upon this plan are capable of very exact calibration which does not change, renders them reliable and efficient where other forms cannot be employed. This is particularly the case in alternating work where nothing else on the market can be accepted as ultimately correct, except Lord Kelvin's highly appreciated standard ampere balances. The series of ammeters which Queen & Company manufacture cover a range of from two-tenths amperes to 500 amperes.

Underwriters Against the Trolley in New York City.

A committee of the Board of Fire Underwriters called on Mayor Gilroy in his office last week for the purpose of protesting against any further extension of the trolley system in the city of New York.

The committee consisted of E. R. Kennedy, president; E. F. Bedall, of the Royal Company, London; John H. Washburne, first vice-president of the Home Insurance Company; Charles E. Shade, agent for several insurance companies; and William A. Anderson, of the survey department of the Board of Underwriters.

President Kennedy told the Mayor that it was necessary for the city authorities to be on their guard against the encroachments of the trolley system. "The Broadway Railroad Company," he said, "would, if they got permission, at once abandon the cable and adopt the trolley."

The Mayor said he had no doubt they would, but they were not likely to get the permission.

Mr. Washburne said that electricity cost the insurance companies a great deal of money, and no form of it was more costly than the trolley. Bare wires were dangerous to life and property. The trolley, he said, might be all right for country places or sparcely populated localities, but it brought fire and death to large towns and cities.

While the fire insurance companies were opposed to the trolley, yet its disadvantages would fall upon the people in the shape of increased rates.

The Mayor said that while he could not interfere with the existing laws permitting trolley roads in the Annexed District, he would give the committee his assurance that before any legislation permitting the extension of the system was consummated, he would give the insurance companies full opportunity to be heard.

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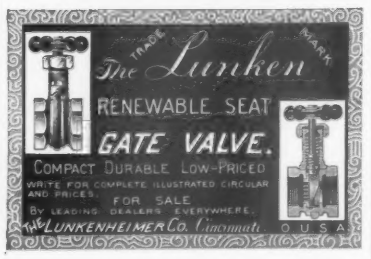

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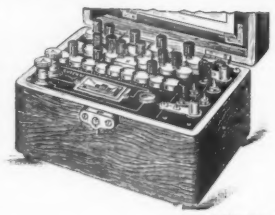

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